SCRF Progress

A.Yamamoto, Marc Ross, and Nick Walker
ILC-GDE Project Managers

ILC-PAC, Eugene, Nov. 11, 2010

What was reported in the 4th PAC ?

- *From the Committee report:*

REPORT OF THE FOURTH MEETING OF THE ILC PROJECT ADVISORY COMMITTEE (PAC)

13/14 May 2010; Valencia, Spain

C. Akira Yamamoto reviewed the progress on SCRF, and gave the goals for this work. Following a second pass, 33% of cavities reached 35 MV/m in October 2009; 44% in January 2010; and 48% in March 2010, based on statistics of ~~~50~~ cavities; the newer cavities have an even higher yield. It appears that most problems are caused by cavity defects. Several schemes are under study for understanding and fixing cavities which fail a first pass. Yamamoto gave test plans for 2010, and for future tests with beam. Industrialization will require an increase from the XFEL's 0.5 cavity/day/vendor to 3.5 cavities /day/vendor if there are 6 ILC cavity vendors. There will be a meeting on ILC cavity industrialization in Kyoto in May 2010.

In answer to a question, Yamamoto said that a strategy still needs to be developed for incorporating cavities of different gradients into a cryomodule.

Corrected,
~30 (= 27)

What was advised by the 4th PAC ?

- *From the Committee recommendations on 'Accelerator':*

4. The PAC is concerned on how to go from 50% first pass SC cavity yield to 90% yield after a second pass in a mass production environment, since the only viable quality control options seem to be visual inspection and X-rays.
5. The GDE should consider cavity industrialization strategies soon. It is very unlikely that building to a performance specification will be cost effective. More realistic is to specify minimum acceptance criteria.
6. Differential cavity yield plots will provide valuable information not readily apparent in the integral yield plots presented to the PAC. For example, one can readily see if the processed cavities are drawn from one or more populations, and can more easily determine the meaning of the mean, and variation of the distribution(s).

-Our response will be discussed in our reports (partly covered by Marc and Nick)

Outline

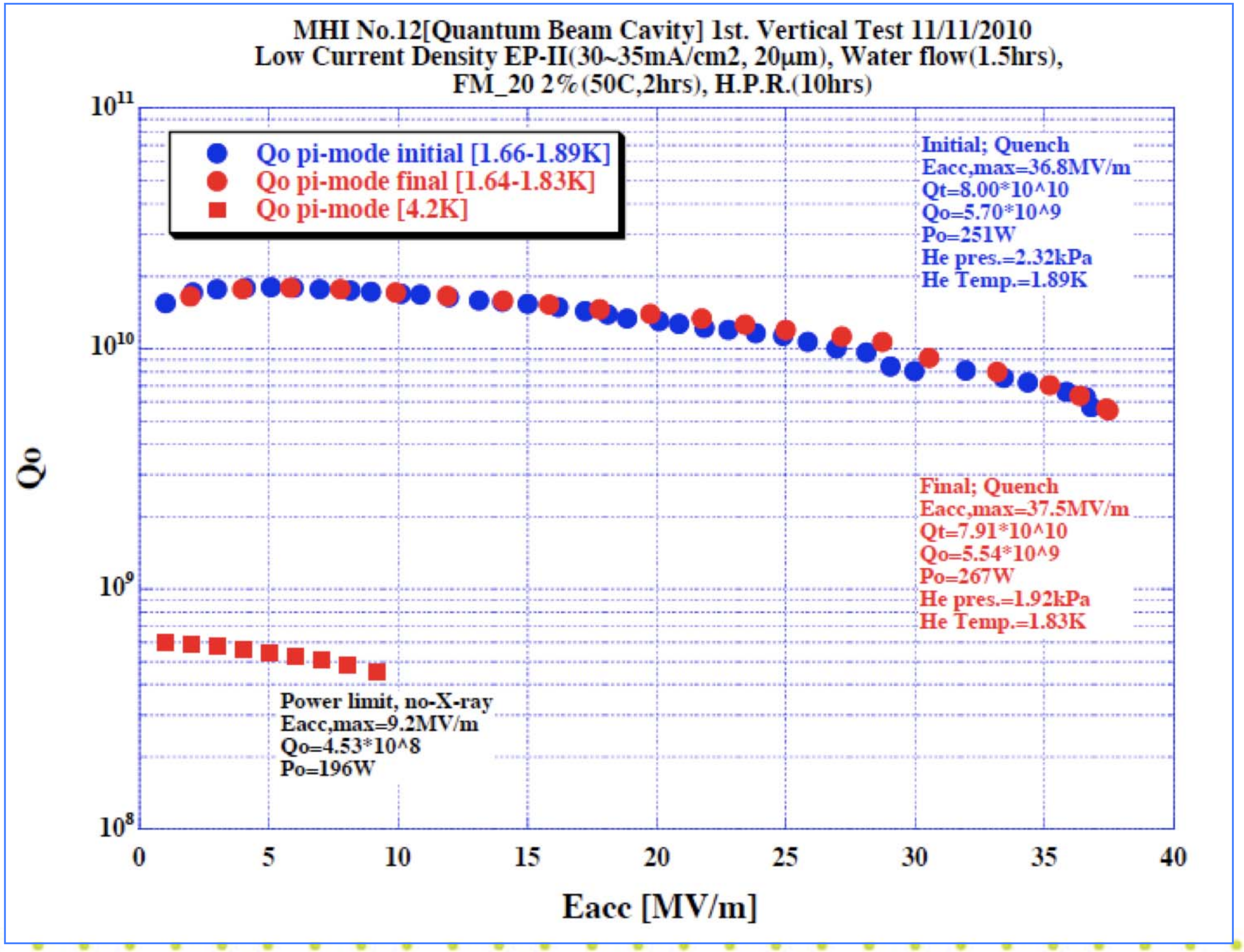
- Highlighted Progress since Beijing Meeting
  - **Topcial progress, this week**
  - **9-cell cavity R&D status**
  - **S1-Global cold test progress**
- Progress from Baseline Assessment Workshop
  - **ML Accelerator Operational Gradient**
  - **Single Tunnel and HLRF**
    - (covered in SB2009 report, N. Walker)
- Plan and Progress to Prepare for Industrialization
  - **(more discussed in Inductrialization report)**

Topical Progress going on This Week!:
Fermilab: NML Cryomodule

- NML-CM1 cryomodule in collaboration of
  - Fermilab, DESY, INFN.

- Cool down is about starting, this week.

KEK: MHI-12 reached 37.5 MV/m in the 1st pass, *TODAY!*



Topical Progress really going on 'this week'

- DESY-FNAL-KEK, Cooperative Work:
  - **Common tuning machines developed by DESY**
  - **One being assembled by FNAL team at KEK**

Global Plan for SCRF R&D

Year	07	2008	2009	2010	2011	2012
Phase	TDP-1			TDP-2		
Cavity Gradient in v. test to reach 35 MV/m	→ Yield 50%			→ Yield 90%		
Cavity-string to reach 31.5 MV/m, with one-cryomodule		Global effort for string assembly and test (DESY, FNAL, INFN, KEK)				
System Test with beam acceleration		FLASH (DESY) , NML (FNAL) STF2 (KEK, test start in 2013)				
Preparation for Industrialization				Production Technology R&D		

SCRF 9-Cell Cavity

Highlight: March ~ Nov., 2010

Americas:

- **Niowave-Roark-FNAL: 1st** cavity reached 28.8 MV/m.
- **Jlab** set an example of ~ 90% **yield** @ **35** MV/m (1 vendor & all process at JLab)
- **FNAL-KEK**: Cavity locally repaired, G improved from **11 to 30** MV/m

Asia (hosted):

- **IHEP-KEK**: 1st cavity (LL, large-grain, no-end) reached 20 MV/m,
- **PKU-JLab**: Cavity (Tesla, fine-grain) reached 28 MV/m,
- **Hitachi-KEK**: 1st cavity (Tesla-like, no-end) reached 35 MV/m
- **MHI-KEK**: QB cavity (Tesla-like w/ end-HOM) reached 37 MV/m, *TODAY !*
- ***MHI-KEK-S1-Global**: cavity (Tesla-like) reached > 35 (40) MV/m*

Europe:

- **E-XFEL / HG-FP7**: 600 cavity production order placed (2 vendors)

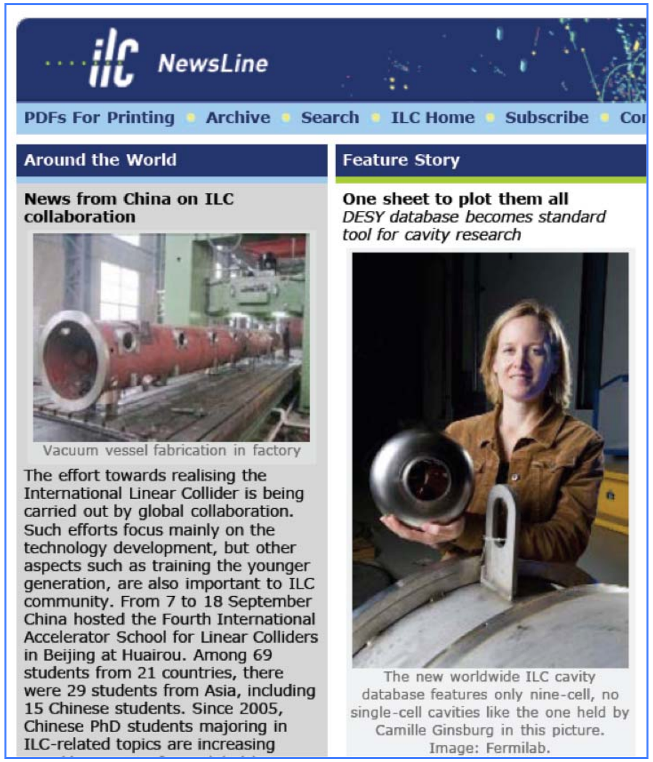
Standard Process Selected in Cavity Production and the Yield

	Standard Cavity Recipe
Fabrication	Nb-sheet (Fine Grain)
	Component preparation
	Cavity assembly w/ EBW (w/ experienced vendors)
Process	1st (Bulk) Electro-polishing (~150um)
	Ultrasonic degreasing with detergent, or ethanol rinse
	High-pressure pure-water rinsing
	Hydrogen degassing at > 600 C
	Field flatness tuning
	2nd Electro-polishing (~20um)
	Ultrasonic degreasing or ethanol
	High-pressure pure-water rinsing
	Antenna Assembly
	Baking at 120 C
Cold Test (vert. test)	Performance Test with temperature and mode measurement (1st / 2nd successful RF Test)

Creation of a Global Database for Better Understanding of "Production Yield" in TDP-2

- Global Data Base Team formed by:
  - **Camille Ginsburg (Fermilab)**
  - **Rongli Geng (JLab)**
  - **Zack Conway (Cornell University)**
  - **Sebastian Aderhold (DESY)**
  - **Yasuchika Yamamoto (KEK)**

- Activity
  - **July 2009:**
    - **- Determine DESY-DB to be viable option,**
  - **Sept., 2009: (ALCPG/GDE)**
    - **- Dataset, web-based, support by FNAL/DESY,**
  - **Dec., 2009: (SB2009)**
    - **- 1st update of the yield statistics**
  - **March, 2010 (IW-ILC, Beijing)**
    - **- 2nd update**
  - **June, 2010 (End TDP-1, and ICHEP)**
    - **- 3rd update**



Cavity Gradient Progress as of June, 20, 2010

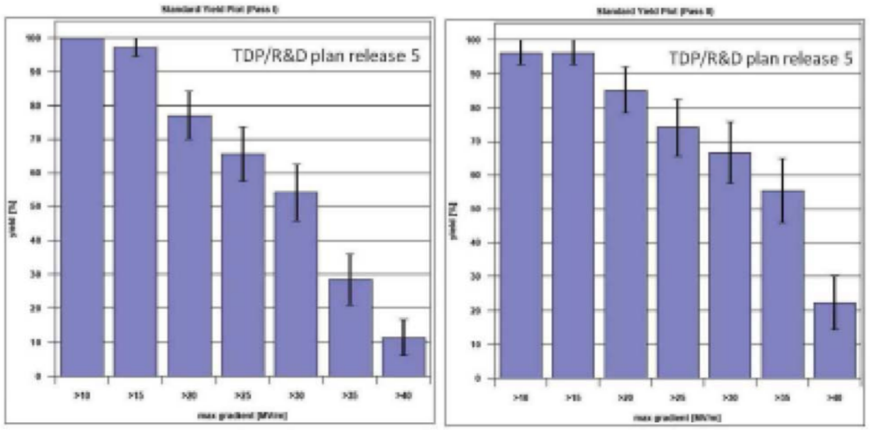


Figure 4.1: First-pass (left) and second-pass (right) yields as a function of maximum gradient. [updated data by June 30.]

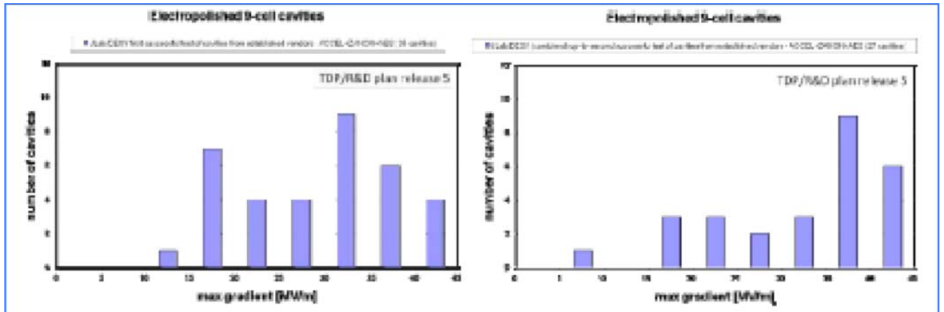
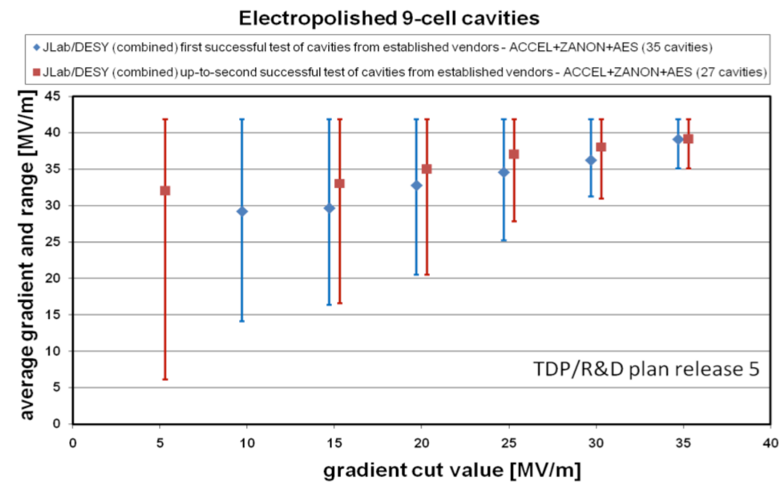


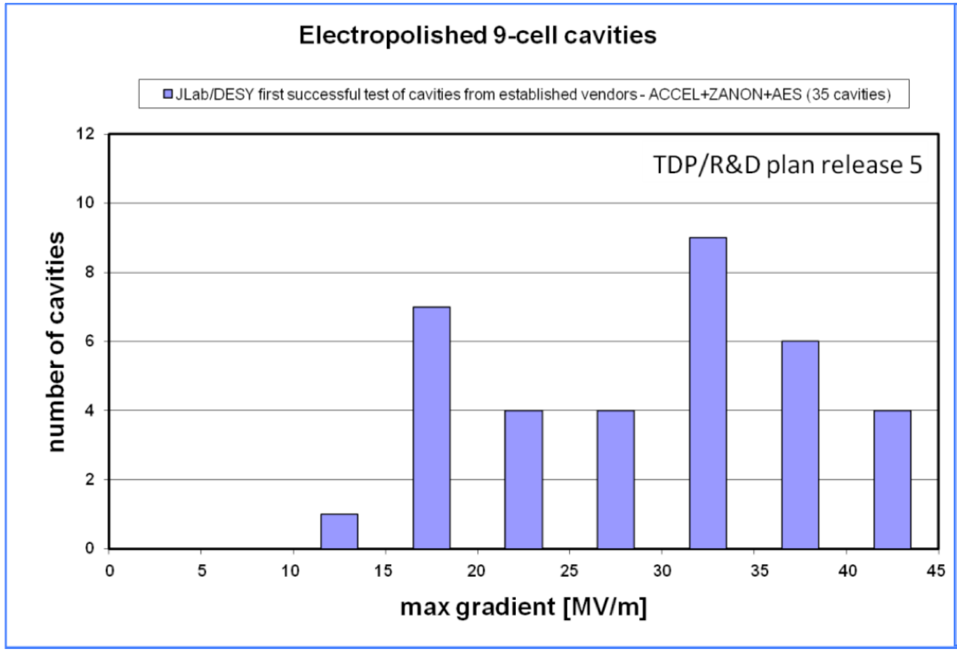
Figure 4.2: Number of cavities as a function of maximum gradient, for first-pass (left) and second-pass (right) data samples. [updated data by June 30.]

- ILC-GDE Cavity Database Team Progress report
  - C. Ginsburg et al.
  - as of June 30, 2010

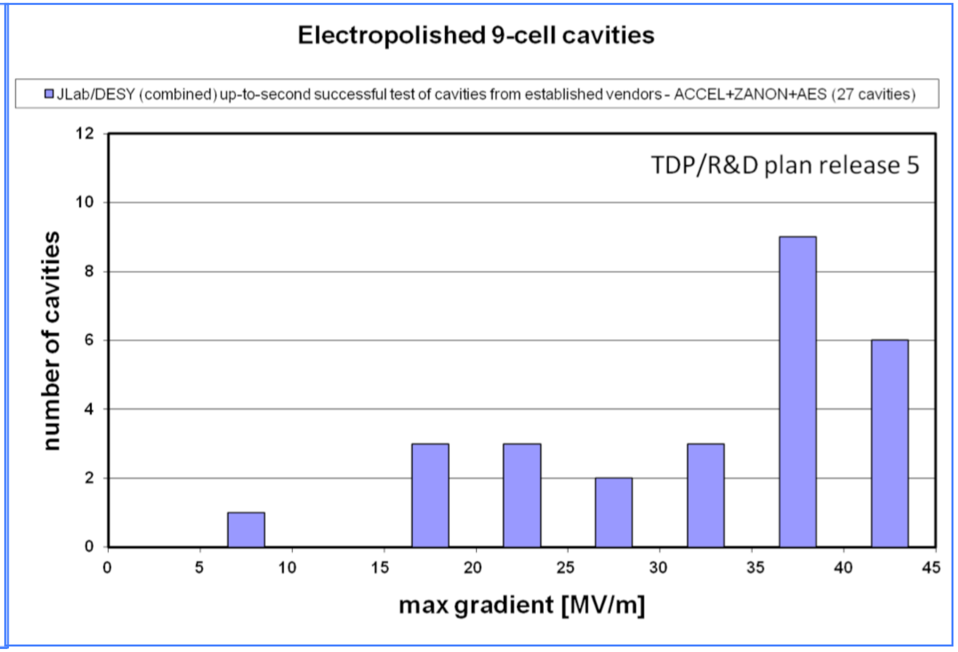
Statistics
- 1st pass: 35
- 2nd pass: 27



Differential Cavity Yield Plots

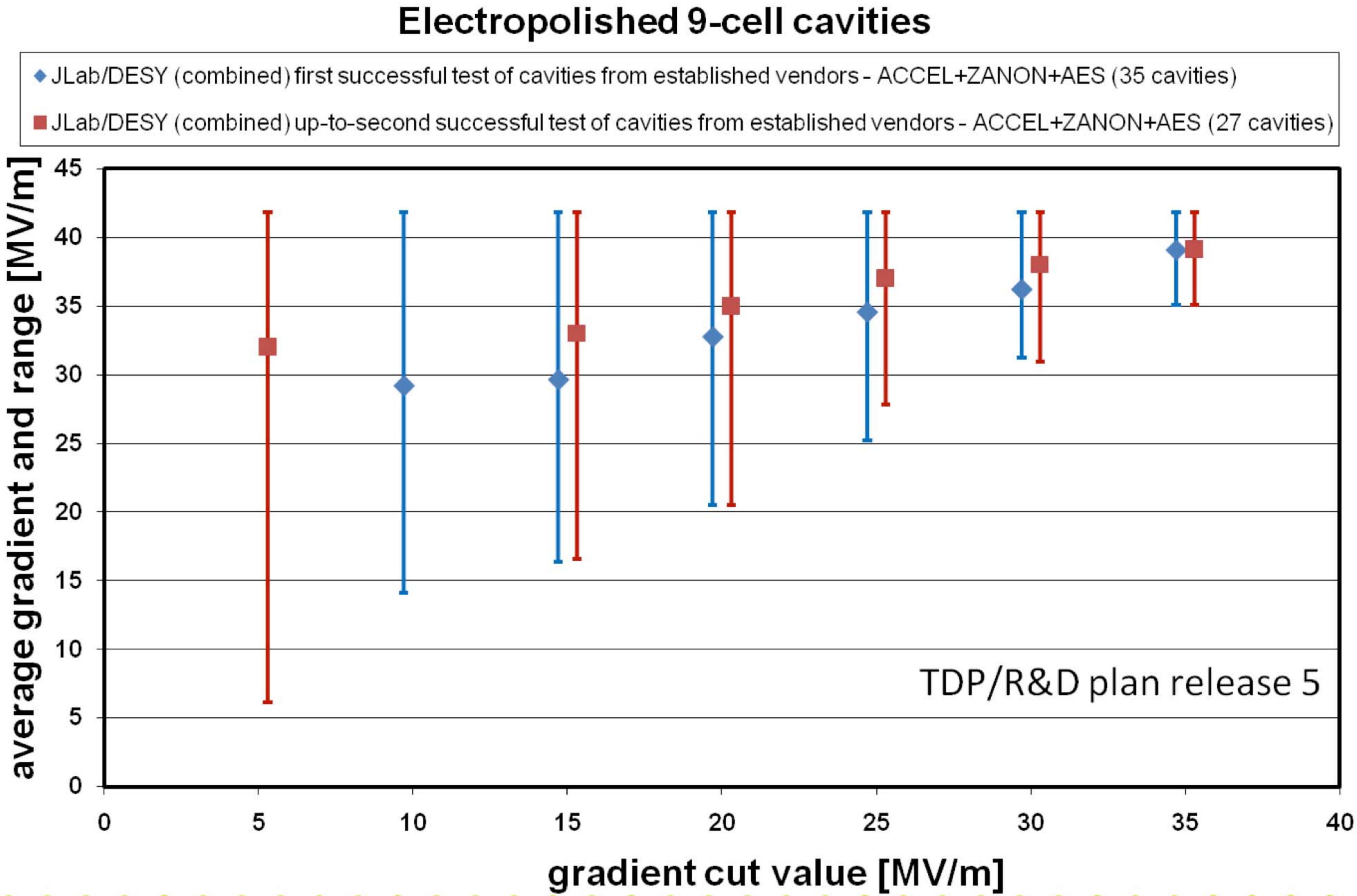


1st Pass

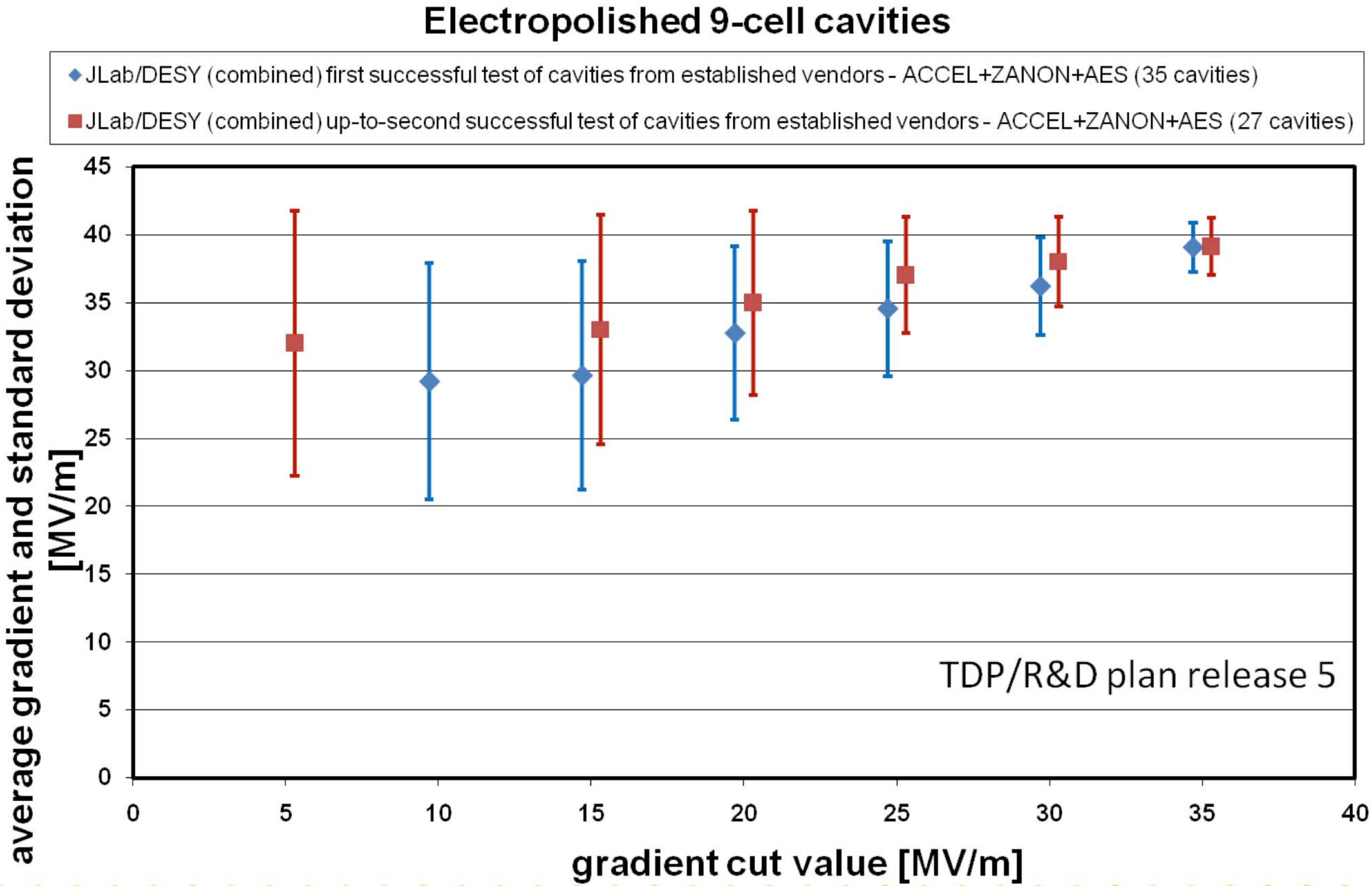


2nd Pass

Average Gradient and Range

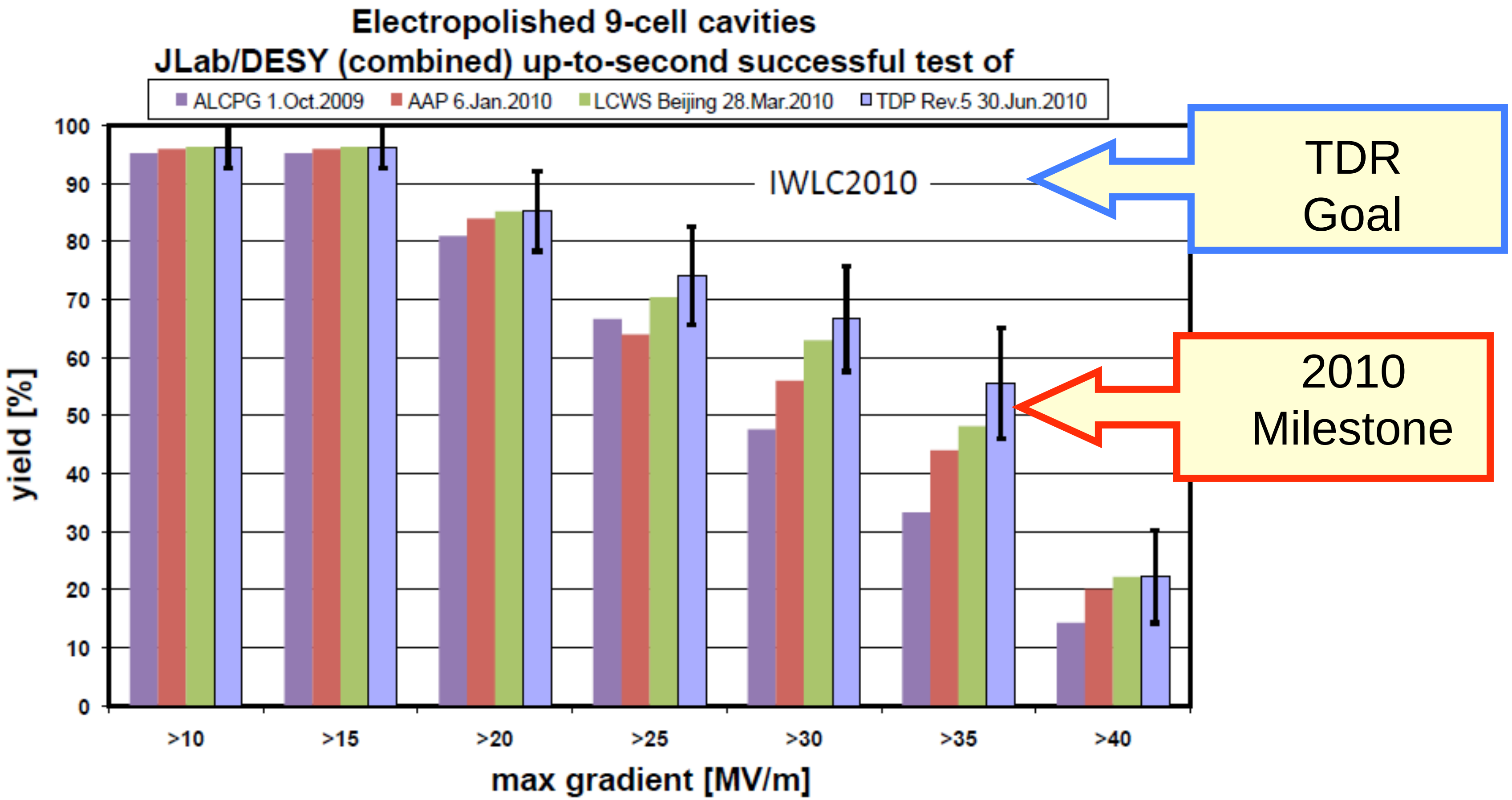


Av. Gradient and Standard Deviation



C. Ginsburg

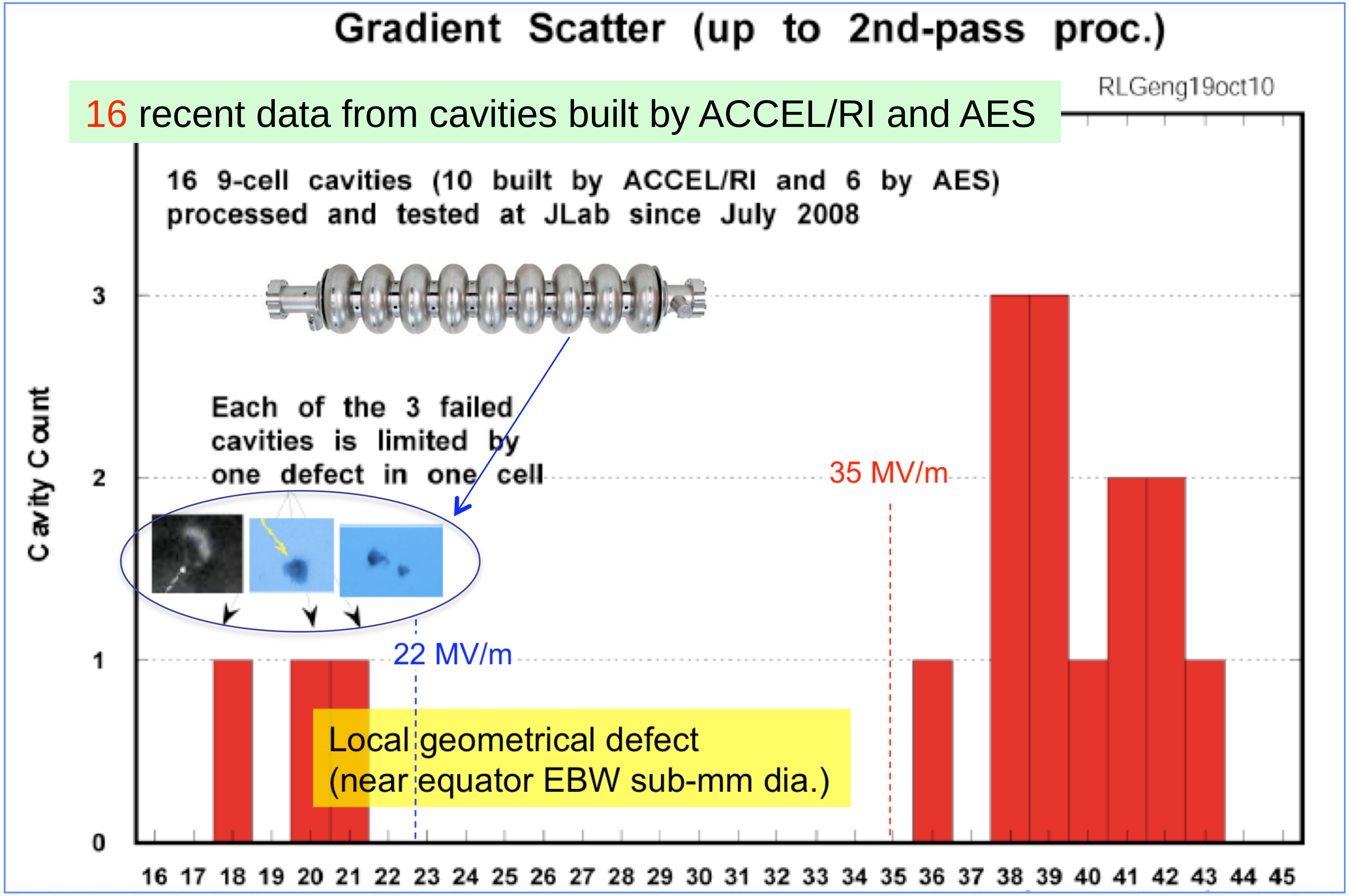
Cavity Gradient Milestone Achieved



81 % Yield at 35 MV/m achieved at JLab

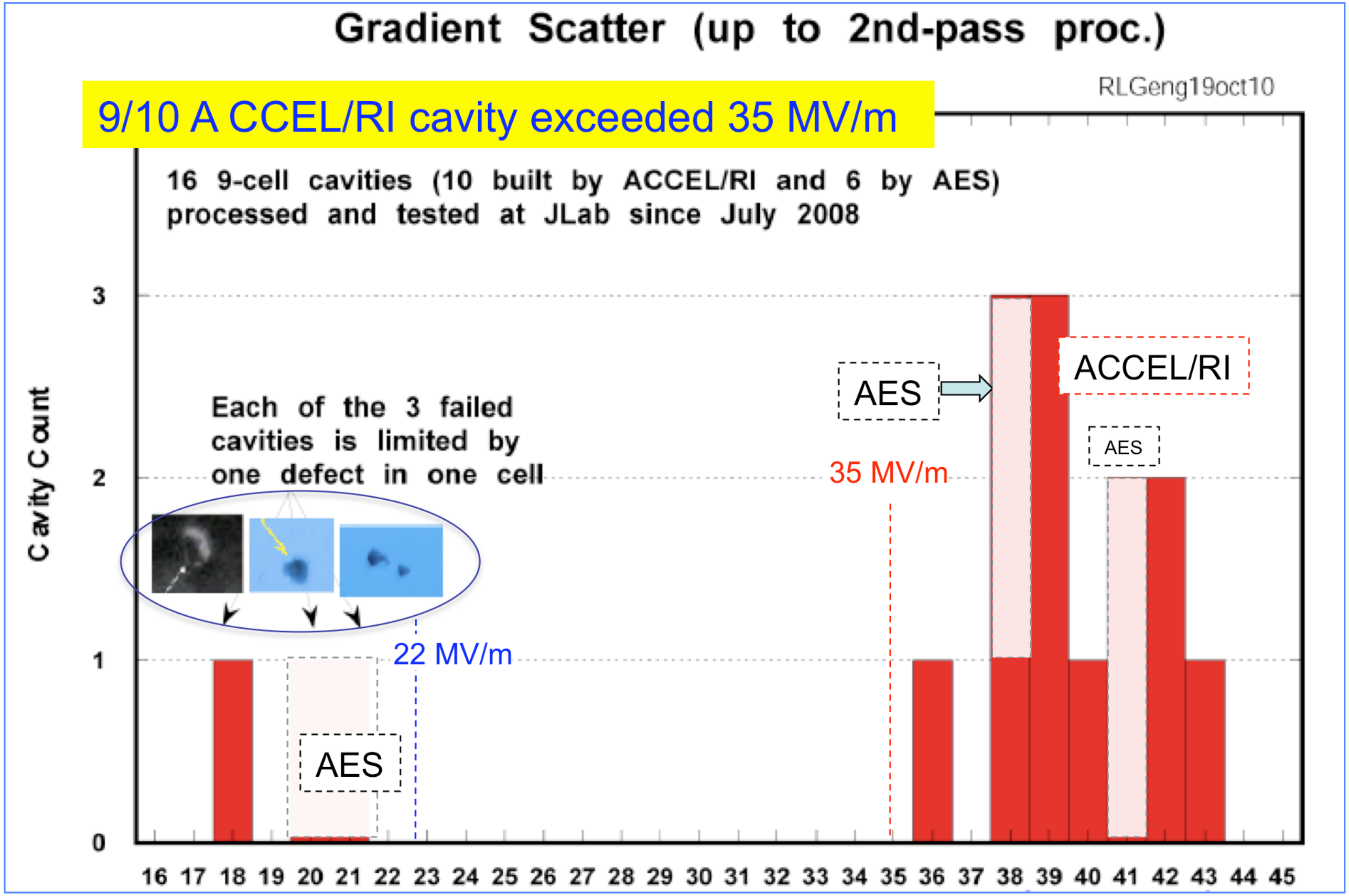
R. Geng

Main Issue, now: Quench Limit ~ 20 MV/m



R. Geng

90 % Yield at 35 MV/m achieved with one vendor and JLab Process/Test



How we may achieve the 90 % yield?

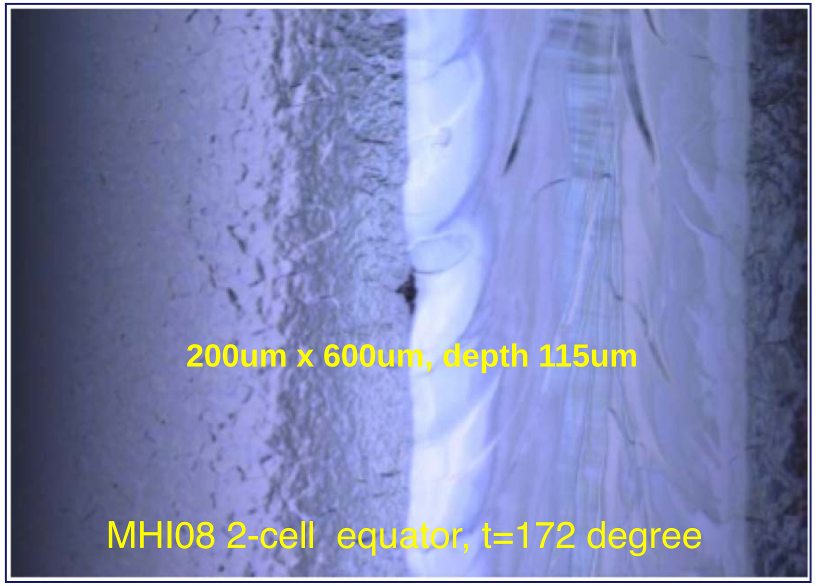
Overcome: Limit at E< 25 MV/m

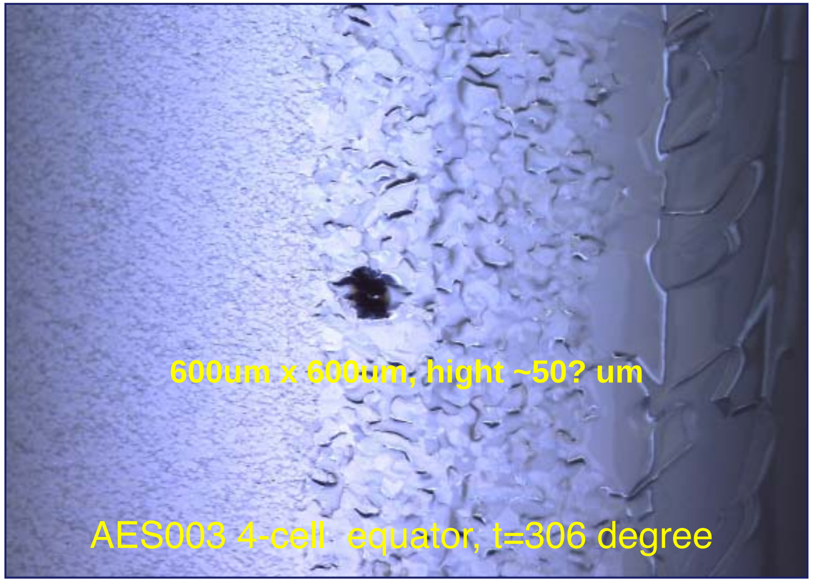
- QC at manufacturing process (at vendor)
  - **Material quality/uniformity including near surface**
    - Need to find novel inspection and acceptance criteria
      - Optical, X-ray, Eddy current: acceptance criteria,
  - **Welding quality control**
    - Need to find clear inspection and acceptance criteria
      - Optical, X-ray, others,
  - **Repair technique**
    - Local grinding, melting, …
- QC at further assembly process (to eliminate degradation)

Improve Gradient toward E > 35 MV/m

- QC at surface preparation process (at vendor & laboratory)
  - **Suppress field emission**
    - Need much more research effort to understand surface and to establish quality control in chemical process and cleaning

Local grinding of quench location





Pit; appeared after bulk EP, limit to 16MV/m

local grinding & EP

27MV/m

additional EP

38MV/m

Local grinder tool

Bump at heat affecting zone, limit to 20MV/m

local grinding & EP

30MV/m

additional HPR and bake

34MV/m

Global Plan for SCRF R&D

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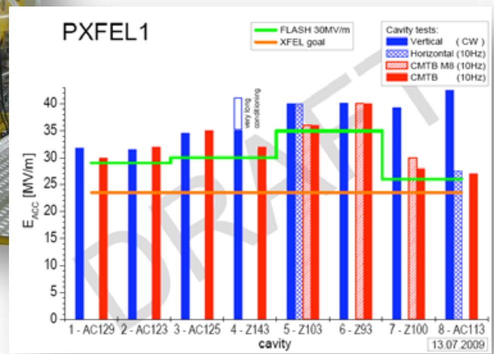
Cavity-string to reach 31.5 MV/m, with one-cryomodule		Global effort for string assembly and test (DESY, FNAL, INFN, KEK)				
System Test with beam acceleration		FLASH (DESY) , NML (FNAL) STF2 (KEK, extend beyond 2012)				
Preparation for Industrialization			Production Technology R&D			

Cryomodule Development & Test

- KEK: STF – S1-Global

- FNAL: Cool-down of CM-1
  - **at new NML facility**

- DESY: XFEL prototype PXFEL-1
  - **<32 MV/m>**
  - **Operational as ACC7 in FLASH (~30MV/m)**



S1-Global Test hosted at KEK

- Hybrid design with components from all three regions
  - **KEK: 4 cavities in 1 cryostat**
  - **DESY: 2 cavities**
  - **FNAL: 2 cavities**

  INFN / KEK cryostat

- Comprehensive test programme
  - **International team**
  - **Cool-down carefully monitored**
    - component alignment
  - **Performance test of different component designs**
    - 2 types of HP coupler
    - 3 types of cavity tuner

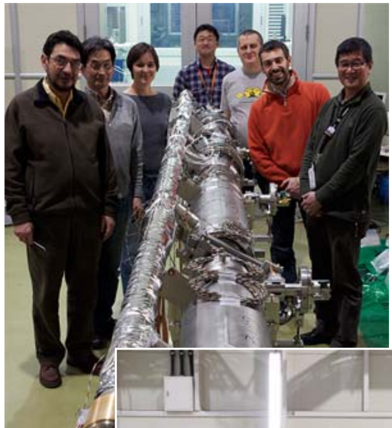
S1-Global Test Progress/Plan

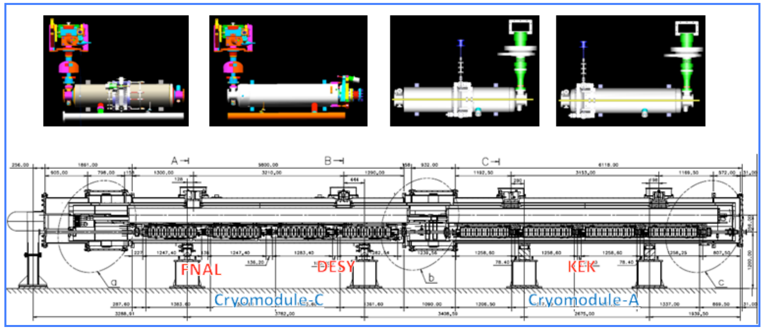
Month	Subjects	Participation (KEK and …)	Down time due to..
Jan-May	Assembly of S1-G Cryomodule	DESY, FNAL, INFN	
June	Cool-down, Low Power Test	IHEP	
July	Low Power Test & Tuner Function Test Preliminary Cryog. Performance test	INFN, FNAL	
August	Input-coupler conditioning		
Sept.	Re-cool-down, Cryogenic Perform. Test High Power Test with RF feedback	DESY	RF: ~1 week
Oct.	High Power test with LFD compensation Cryogenic Perform. Test (Dynamic Load)	FNAL, IHEP	RF: ~ 1 week
Nov.	Control, LLRF Cryomodule Perform. Test (Dynamic load) DRFS preparation,	FNAL	Cryogenics: ~ 2 weeks
Dec./ Jan/Feb	LLRF, DRFS test using S1-Global setup		

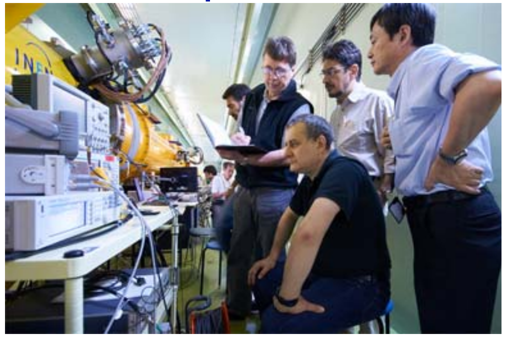
S1-Global Assembly/Test with Global Effort

DESY, FNAL, Jan., 2010

DESY, Sept. 2010







FNAL & INFN, July, 2010

INFN and FNAL Feb. 2010

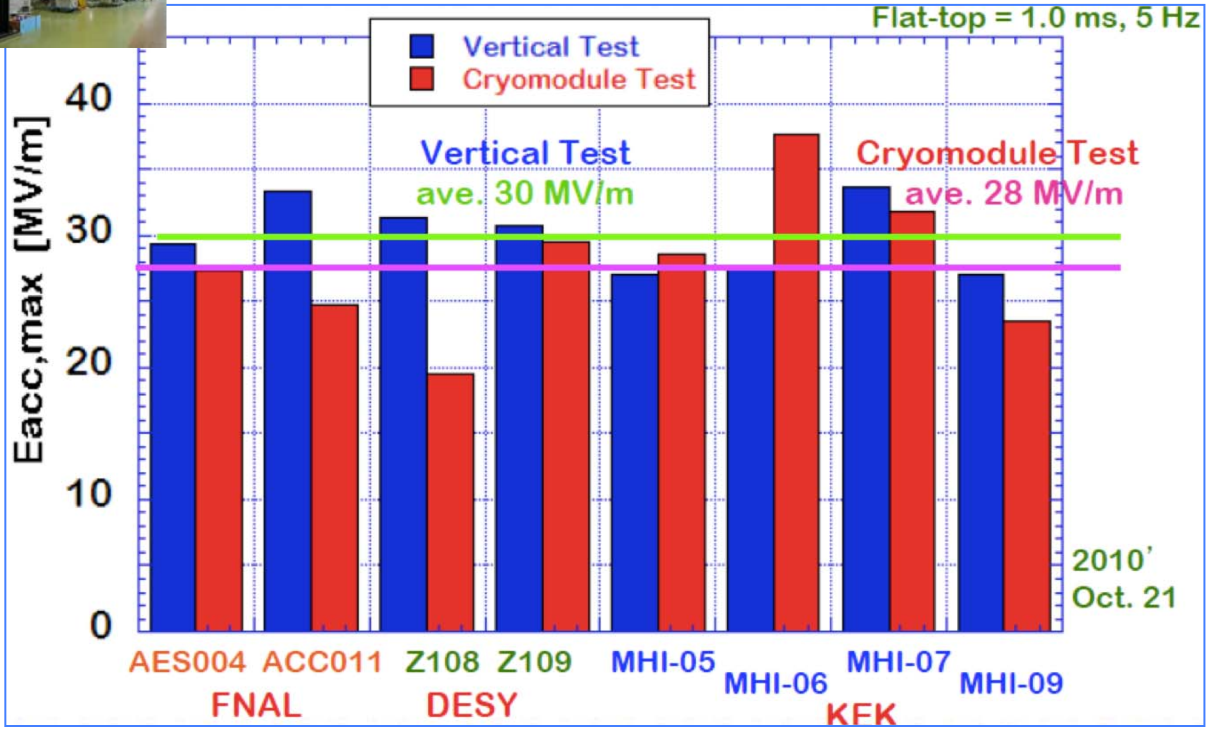
March, 2010

DESY, May, 2010

June, 2010 ~

S1-Global Cryomodule Test in Progress

DESY, FNAL, INFN, KEK, SLAC cooperation and IHEP participation



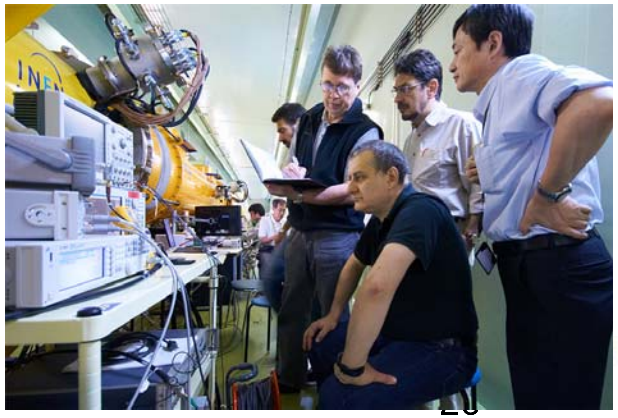
Vertical cavity test

- CW low power test reached:
  < 30 MV/m >

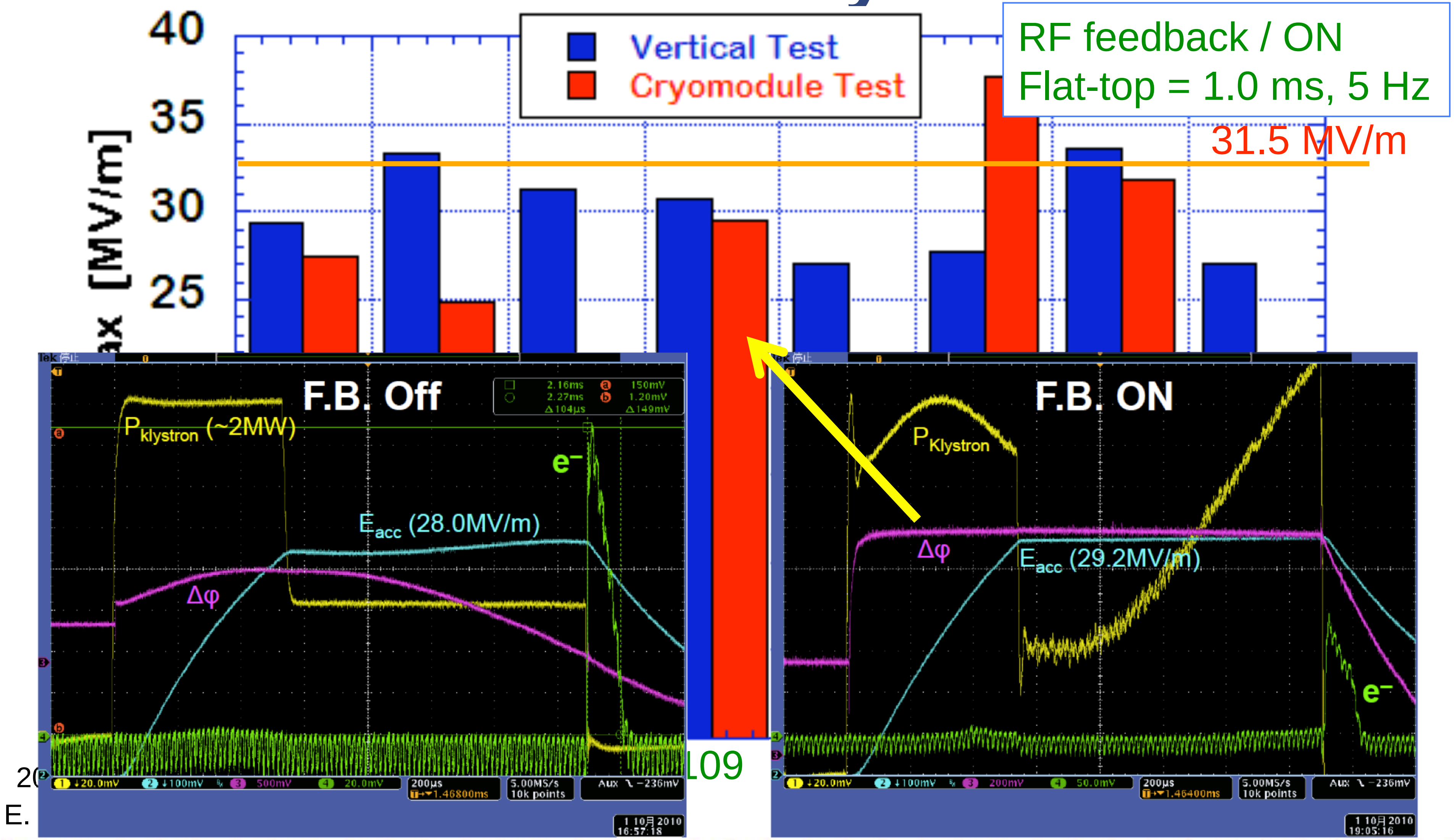
S1-Global cryomodule

- 1ms, 5 Hz pulse Individual test reaching:
  < 28 MV/m >

{as of Oct. 22, 2010}

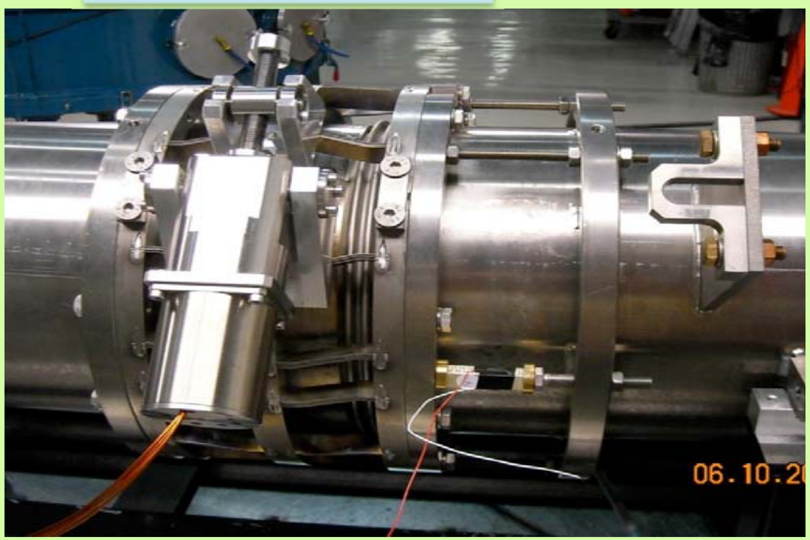


RF-feedback Succeeded to Stabilize Cavity Gradient

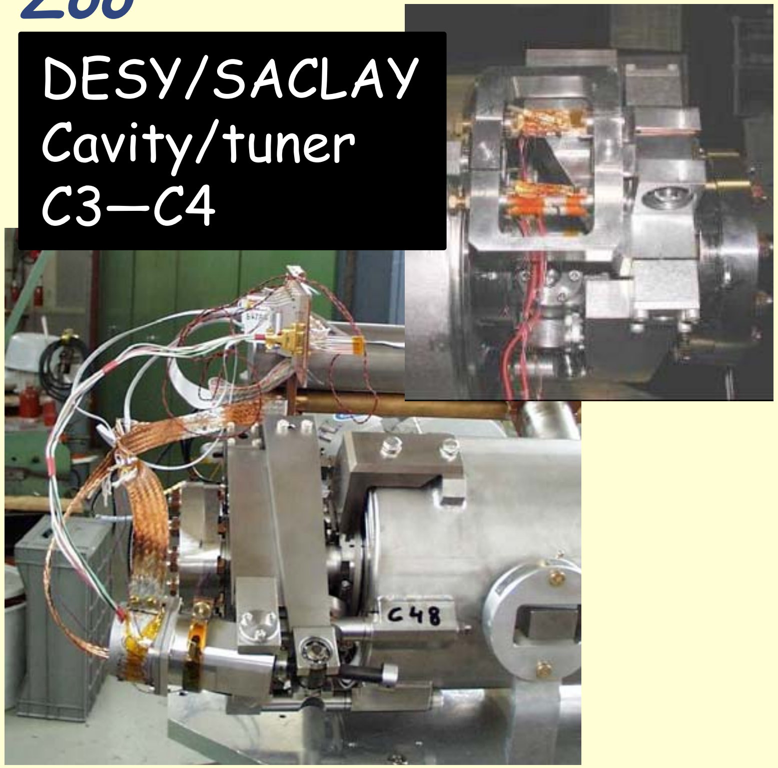


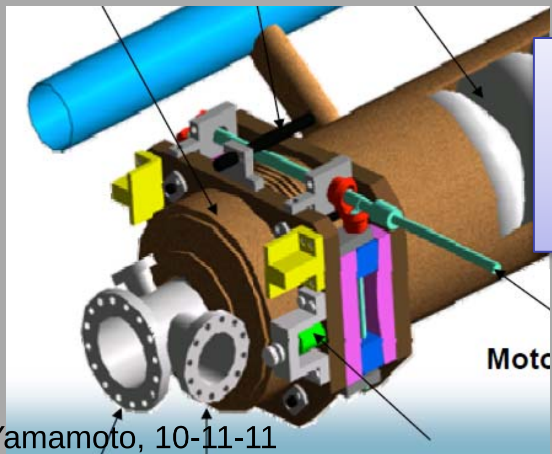
S1 Global cavity/tuner Zoo

Blade Tuner
FNAL/INFN
cavity/tuner C1-C2

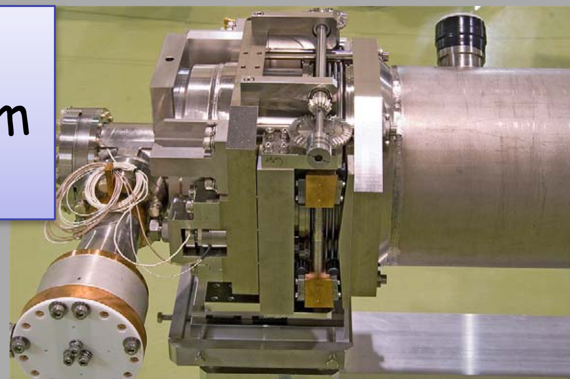


DESY/SACLAY
Cavity/tuner
C3—C4



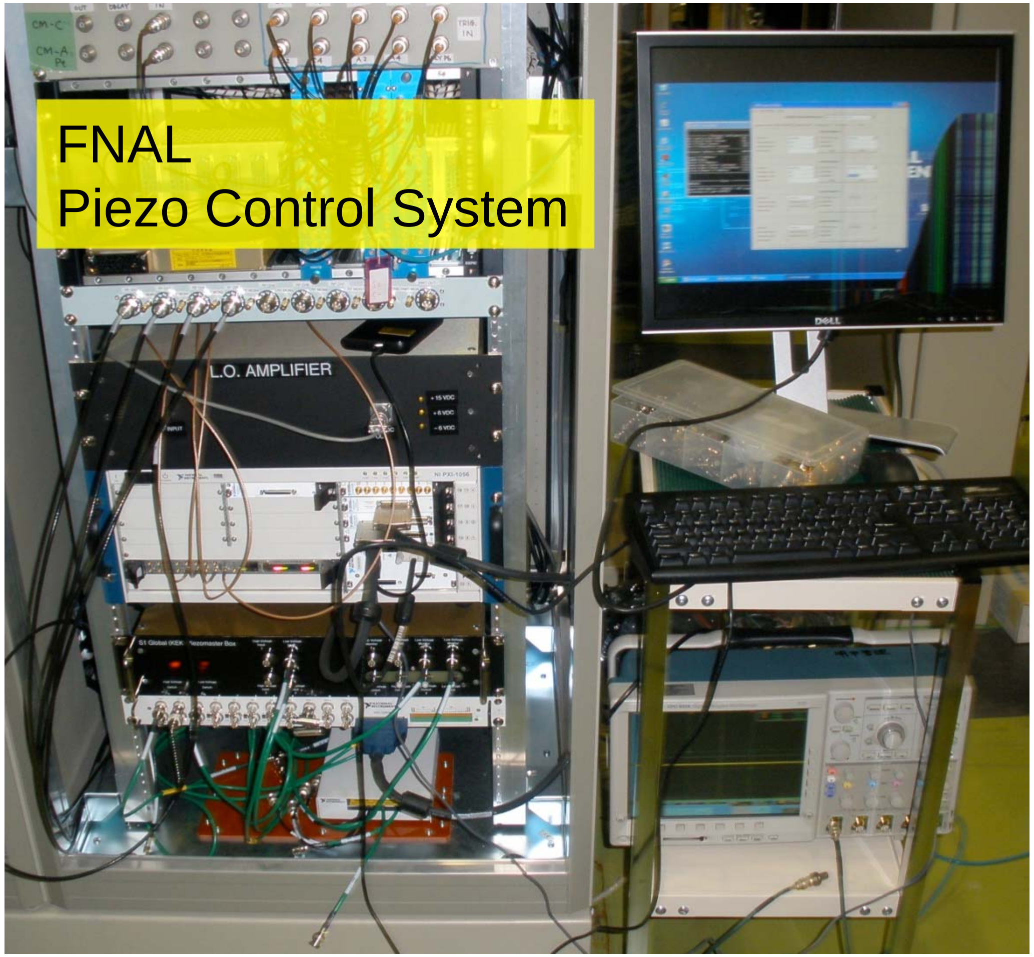


Slide Jack Tuner
KEK cavity/system
A1-A2&A3-A4



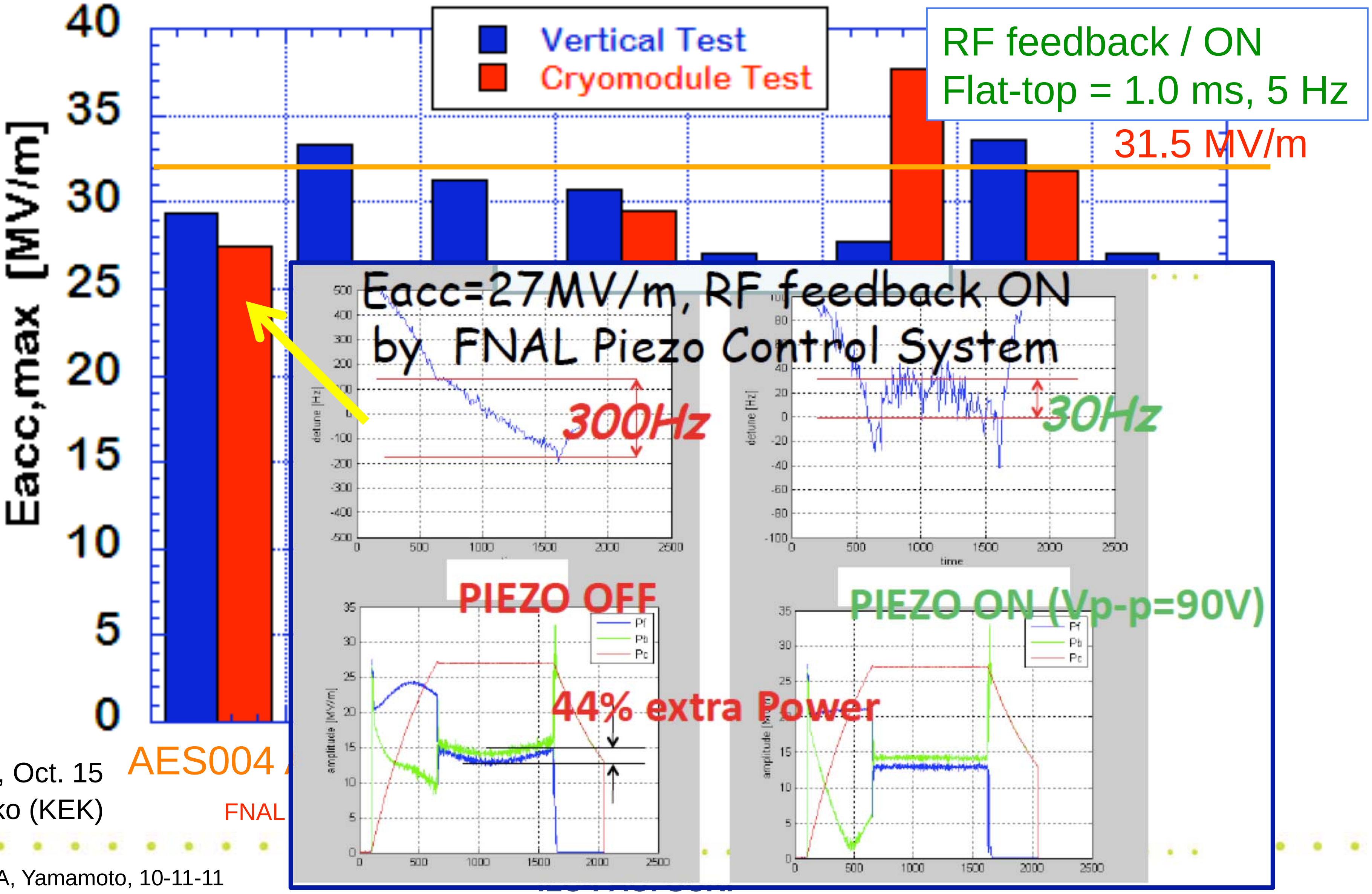
FNAL's Piezo Control System

commonly used for various tuner tests



Yuriy and Warren (FNAL team) working hard in preparation

Piezo-tuner Succeeded to compensate Lorentz Force Detuning



Many Thanks for Global Cooperation

S1-Global High Power Test at STF/KEK, Sep.-Oct, 2010

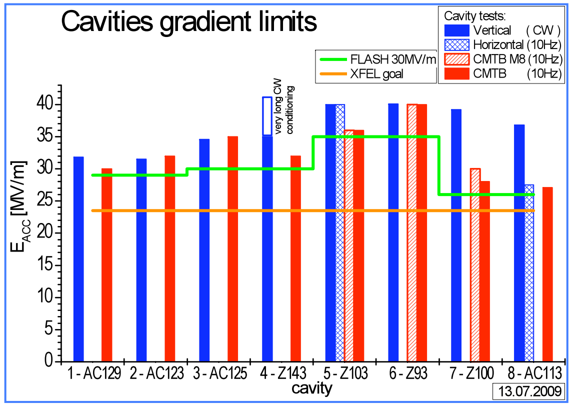
Denis Kostin
(DESY) Sept. 2010

Yuriy Pischalnikov
Warren Schappert
(FNAL) Oct. 2010

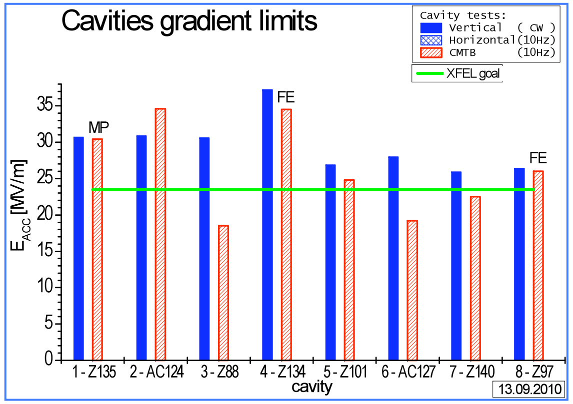
D. Kostin & E. Kako

Cryomodule Gradient Spread

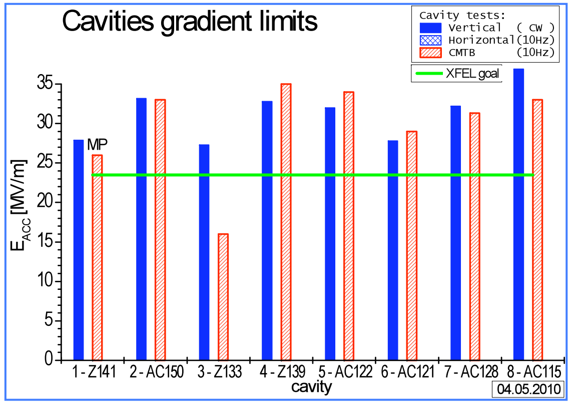
Observed at DESY and KEK, as of Nov. 2010



PXFEL-1

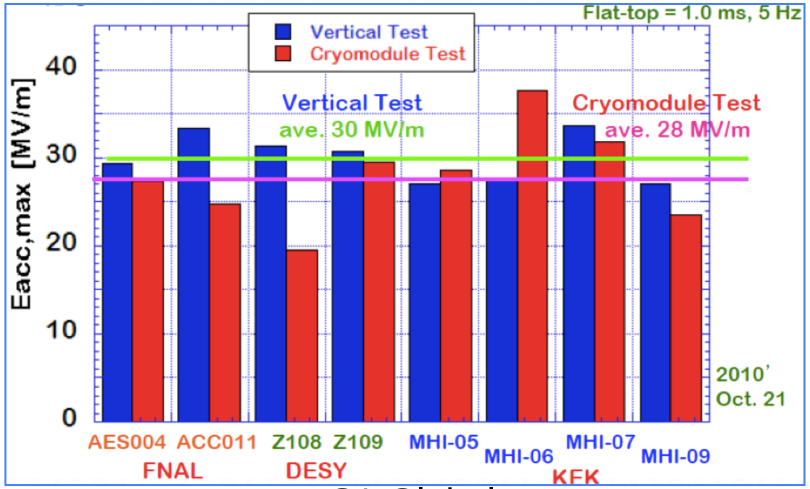


PXFEL-2



PFEL-3

- FLASH:
  - **3 PXFEL cryomodules**
- ILC-TDP:
  - **S1-Global cryomodule**



S1-Global

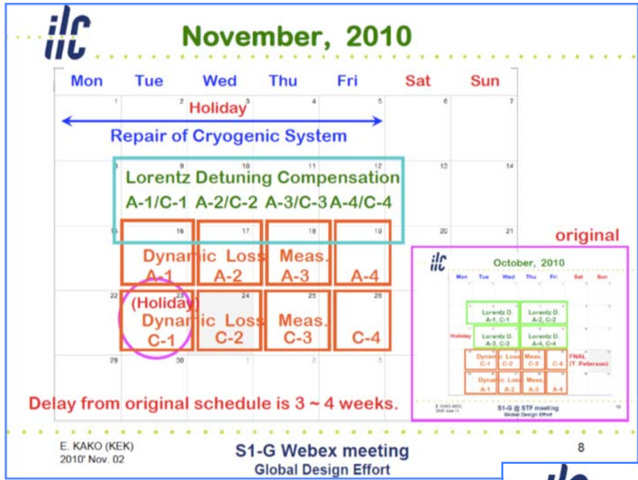
Average Gradient Observed

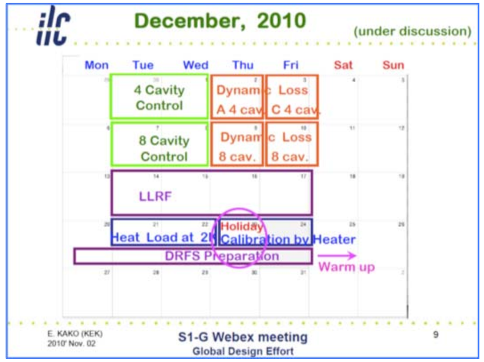
in Cavity/Cryomodule Tests at DESY and KEK

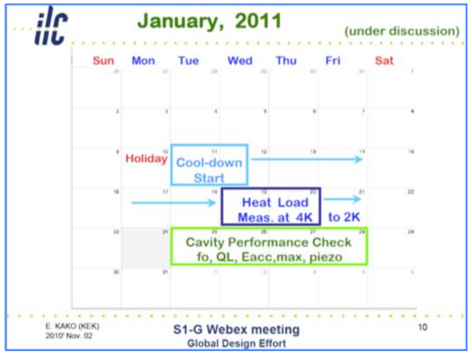
Project: Cryomodule	XFEL: PXEL-1	XFEL: PXFEL-2	XFEL: PXFEL-3	ILC-TDP: S1-Global		ILC: Spec.
9-Cell Cavity Vertical Test (CW-mode)	< 36 >	< 31 >	< 30 >	**< 30 >**		< 35 >
Cryomodule Test (10 or 5 Hz)	< 32 >	< 30 >	< 25 >	**< 28 >**		< 34 >
G. degradation VT→CMT, %	~10 %	~ 4 %	~15 %	**~ 7 %**		≤ 3 %
Accelerator Operation (10 or 5 Hz)	< 30 > used in FLASH (ACC7)	N/A	N/A	N/A		< 31.5 >

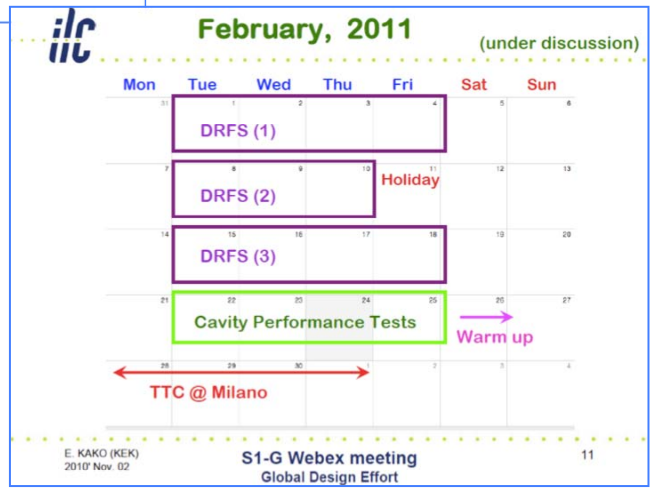
Schedule for DRFS test at S1 global
(Schedule, 2 months to be extended)

- S1 schedule delayed for about one month due to technical problems in:
  - **RF source #1,**
  - **He refrigerator**
- DRFS test
  - **rescheduled in Feb., 2011 after re-starting cool-down in Jan.,**
- 2 Klystrons delivered.
- Delivery of a DC p/s and a modulator is expected.
- High Power RF test is to be completed in middle of Dec.



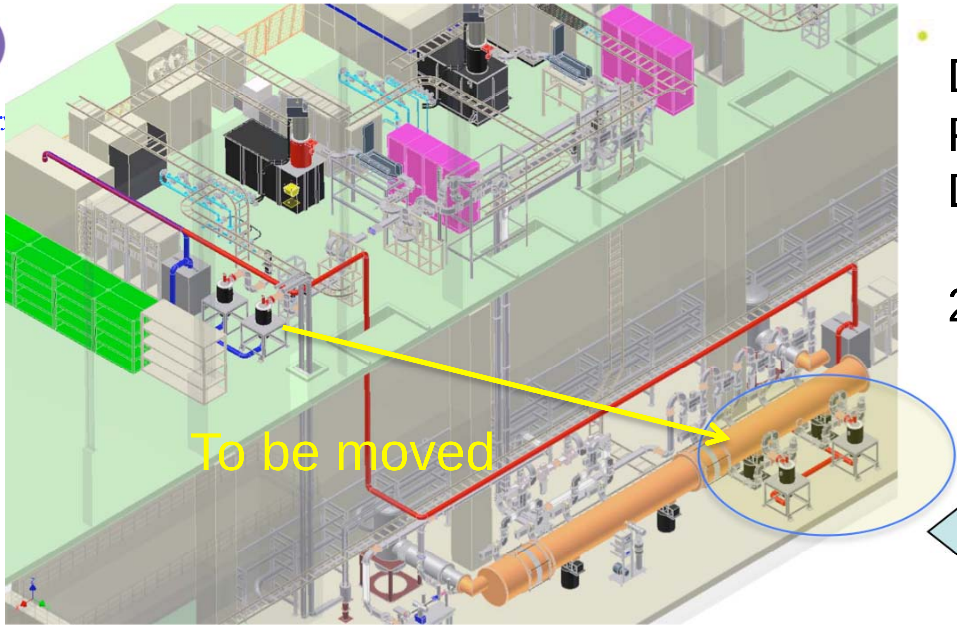






DRFS Test in S1-Global

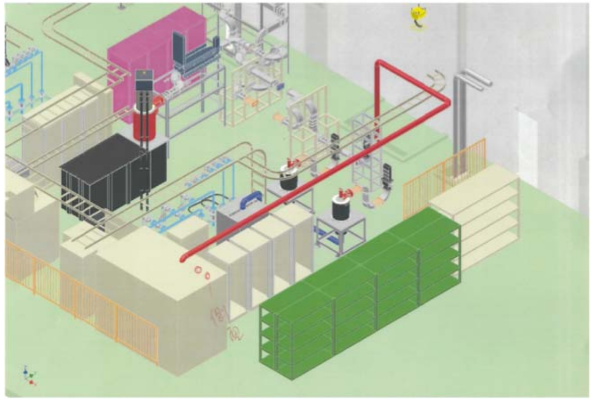
to be more reported in the SB2009 report by N. Walker



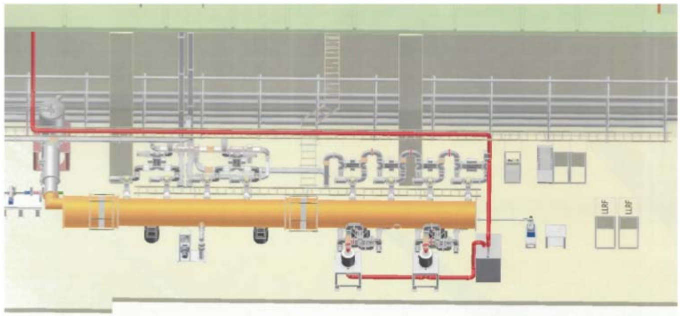
DRFS demonstration will be Prepared in the end of S1-global: December of 2010.

2 units DRFS

Birds eye view of STF site



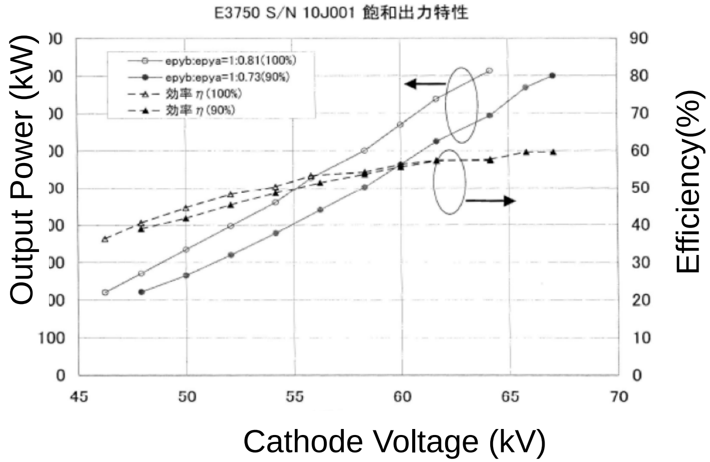
First evaluation test is done in klystron gallery



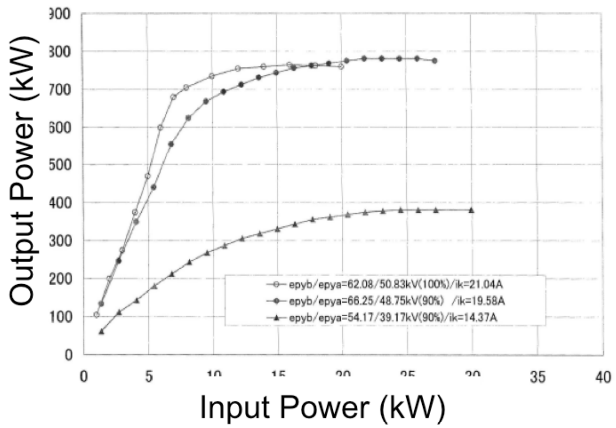
Then 2 DRFS units are connected to the four cavities in the cryomodule.

Progress of prototype DRFS Klystrons

E37501 #1 Saturation
power vs applied voltage



E37501 #1 Input-output characteristics



Achieving data

Original design was 750kW but same Design achieved More than 800kW.

No. 1 DRFS klystron: 806.7kW at 67.1kV (Micro-perveance=1.15), Eff.=**60.1**%

813.0kW at 64.2kV (**Micro**-perveance=1.36), Eff.=**57.4**%

Two prototype DRFS klystrons
Are waiting for test.

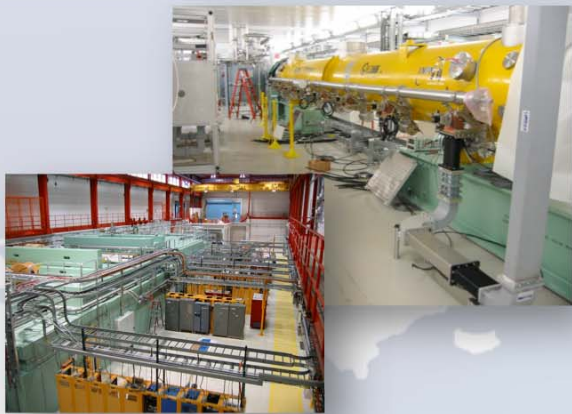
Waveform

Global Plan for SCRF R&D

Year	07	2008	2009	2010	2011	2012
Phase	TDP-1			TDP-2		
Cavity Gradient in v. test to reach 35 MV/m	→ Process Yield 50%			→ Production Yield 90%		
Cavity-string to reach 31.5 MV/m, with one-cryomodule		Global effort for string assembly and test (DESY, FNAL, INFN, KEK)				
System Test with beam acceleration		FLASH (DESY) , NML (FNAL) STF2 (KEK, extend beyond 2012)				
Preparation for Industrialization				Production Technology R&D		

Integrated Systems Tests

- to be reported later by M. Ross -



NML (FNAL)

- Under construction
- Up to 6 cryomodules
- Operation: end 2012
  - (3 CM)

FLASH (DESY)

- TDP focus
- 7 CM → 1.2 GeV beam
- photon user facility

STF (KEK)

- "Quantum Beam" experiment 2011
- 1 CM with beam 2013
- (2 CM 2015)

Full systems integration testing

"9mA experiment" achieved ~1800 bunches at 9mA in 09.2009

$\Delta E/E_{RMS}$ ~0.5% (@ 0.8 GeV)

~0.1% within pulse

TLCC Process

(covered by B. Barish and N. Walker)

1. Accelerating Gradient
2. Single-tunnel (HLRF)

1st BAW
KEK 7-10th Sept. 2010

Proposals submitted to director

Issue Identification

- Planning
- Identify further studies
- Canvas input from stakeholders
- …

Baseline Assessment Workshops

- Face to face meetings
- Open to all stakeholders
- Plenary

Formal Director Approval

- Change evaluation panel
- Chaired by Director

keywords: open, transparent

A Proposal for Cavity Gradient Balance

- from our report in the previous PSC, May, 2010 -

- Appropriate balance should be re-considered b/w
  - **R&D stage and Project stage**
  - **Components and Accelerator System Operation**

- A new guideline toward TDP-2 and TDR
  - **R&D Goal for Cavity Gradient (unchanged) : 35 MV/m (@ 90 % yield)**
  - **Guideline for System Engineering to be updated**
    - with allowing gradient spread

  - G_{Cavity} > $G_{Cryomodule}$ > $G_{ILC\text{-}operation}$
  - **<35 MV/m> : <33 MV/m> : <31.5 MV/m>**

→ In BAW-1, we propose <34 MV/m>

- Our homework
  - **How much gradient spread to be allowed?**
    - To be optimized within 10 – 20 % in balance of RF distribution efficiency
  - **Can we justfy the above operational margins?**
    - ~ 5 % in Cavity (itself) operational margin in cryomodule operation
      - To prevent excessive field/field-emission/cryogenics-load and quench
    - ~ 5 % in LLRF/HLRF and beam tune-ability and operational margin or overhead
      - We shall learn FLASH/NML/STF progress in TDP-2

ILC-ML SCRF Cavity Gradient Specifications Update

Cost-relevant design parameters for TDR	ML cavity gradient Specification	R&D Milestone
9-cell Cavity Gradient in vertical test	35 MV/m, average - Spread: 28 – 42 MV/m (+/- 20 % or less)	35 MV/m at 90 % yield including 2nd pass, (eq. > 38 MV/m, average)
Cryomodule Operational Gradient	34 MV/m, average	34 MV/m, average CM Obs. G. Limit = 3 %
Accelerator Operational Gradient	**31.5 MV/m, average** - Spread: 25 – 38 MV/m (+/- 20 % or less: TBD)	31.5 MV/m, average Op. G lim = 1.5 MV/m Cntrl margin = 3 %**
Required RF power overhead for control	10-15%	

Effect on the RF Source Installation

- DRFS:
  - **+ 20 % RF capacity, nominally, required**
    - corresponding to 31.5 x 1.2 = 38 MV/m under control, and
    - 800 kW DRFS-Klystron may be sufficient
  - **In operation,**
    - Modulator power is grouped in 5 level, then the averaged additional operation power is to be **~ + 4 %** in case of 5 levels,
- KCS:
  - **+ 12 % RF capacity, nominally, required,**
    - Can be more averaged with KCS system,
- Further study to be integrated

Effect of Gradient Spread on RF Capacity and Operational Power Balance

Operational Division	Gradient range	Operational Power req.
120 - 112	37.8 – 34.7	120 %
112 - 104	34.7 – 32.8	112
104 - 96	32.8 – 30.2	104
96 - 88	30.2 – 27.7	96
88 - 80	27.7 – 25.2	88

Possible sorting:

- Assuming to sort the gradient in each production year
16,000 cavities / 5~6 years / 5 bins > 500 cavities in each bin

- AC Operational Power additionally required : + 4 %

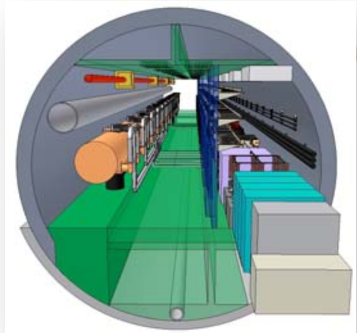
Accelerator Gradient Balance Summary

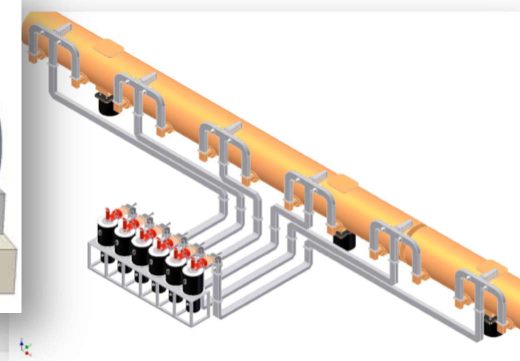
- Two guidelines established
  - **R&D milestone:**
    - 35 MV/m with 90 % yield (eq. > 38 MV/m on average) , including 2nd pass,
  - **ILC ML Cavity manufacturing specification:**
    - 35 MV/m on average with spread (≤ +/- 20 %) ,
- ILC-ML Accelerator Gradient (as baseline approved)
  - to be kept at 31.5 MV/m on average
    - With gradient spread (< ~ +/-20 %).
  - additional HLRF capacity of 10~15 % required.

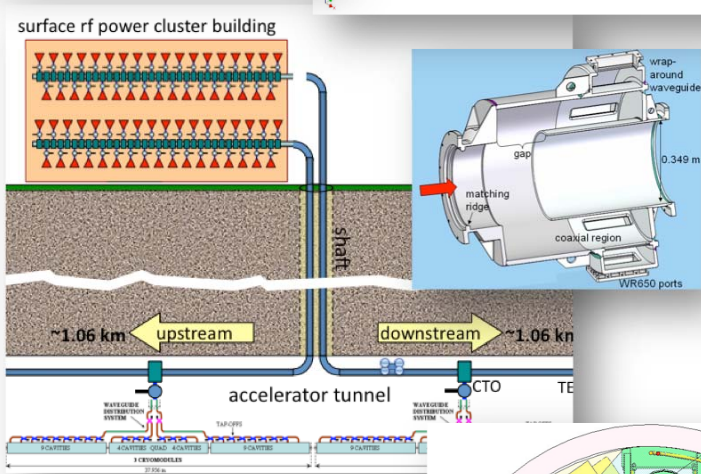
Single Tunnel Options (HLRF)

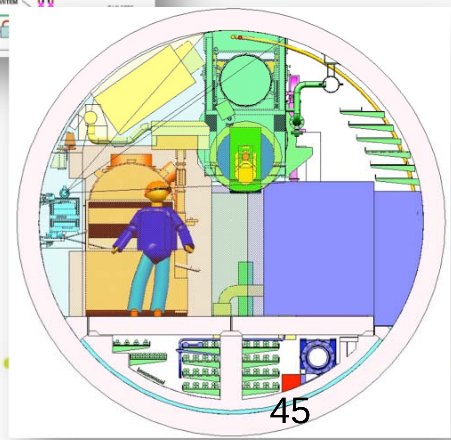
to be reported more in SB2009 talk by N. Walker

- Distributed RF Sources (DRFS)
  - **800 kW MAK**
  - **Everything in tunnel**
- Klystron Cluster Scheme (KCS)
  - **Surface clusters of klystrons (2×32 MBK)**
  - **RF power distributed via over-moded waveguide (350 MW)**
    - ±1 km
- RDR HLRF Technology
  - **e.g. XFEL-like solution (pulsed cables)**
  - **Back-up (risk-mitigation)**



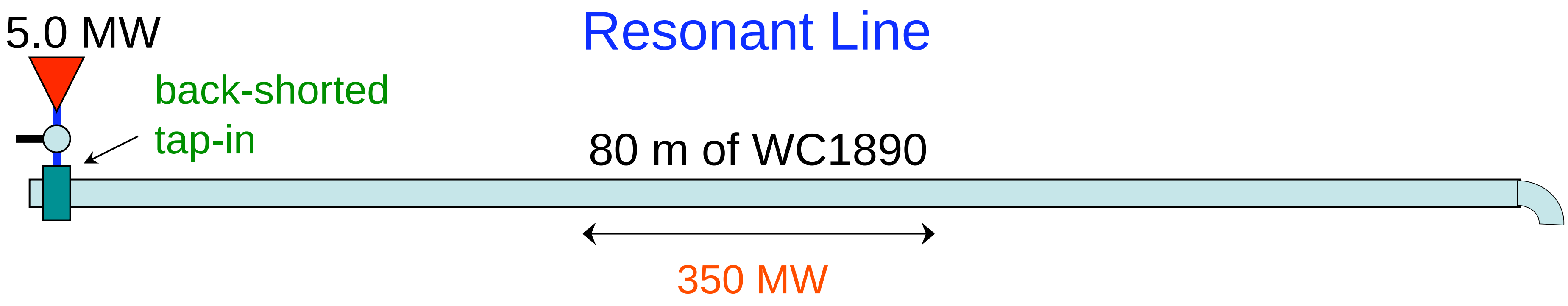




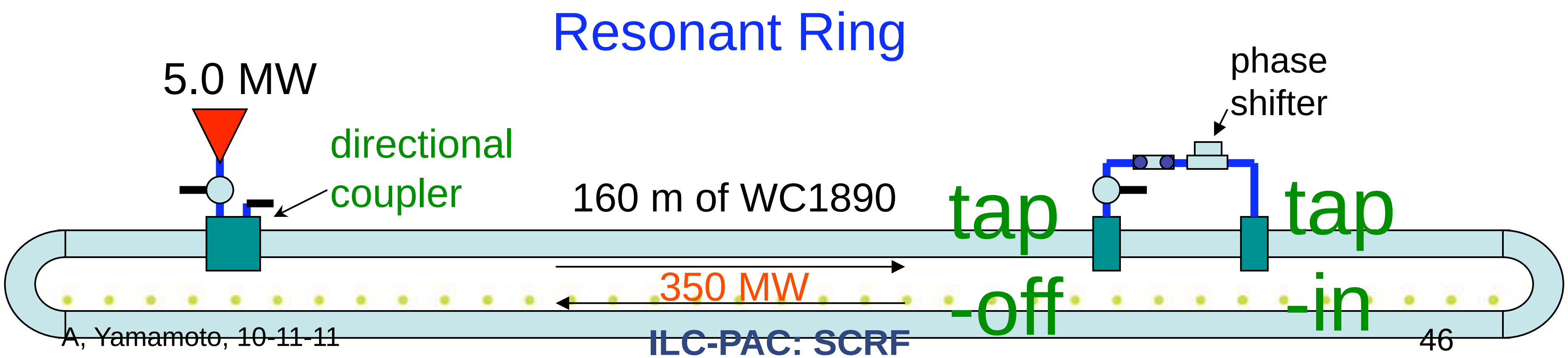


KCS Power Distribution System R&D

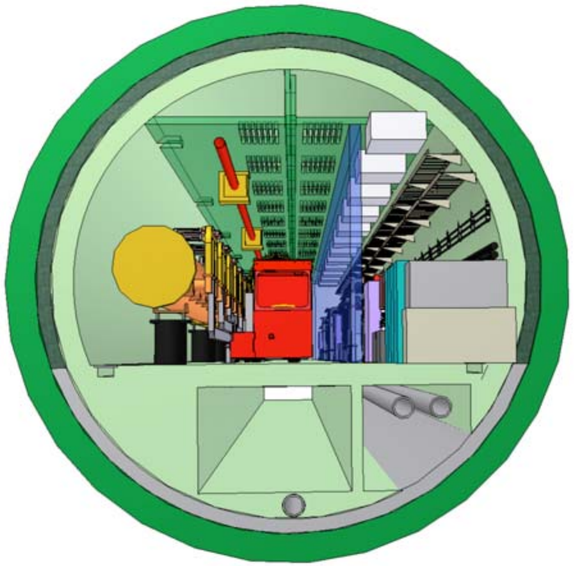
In FY11: extend pipe system to 80 m and add bend prototype

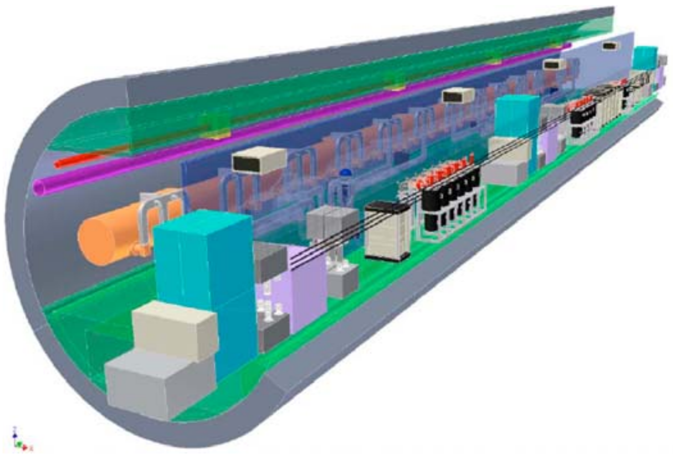


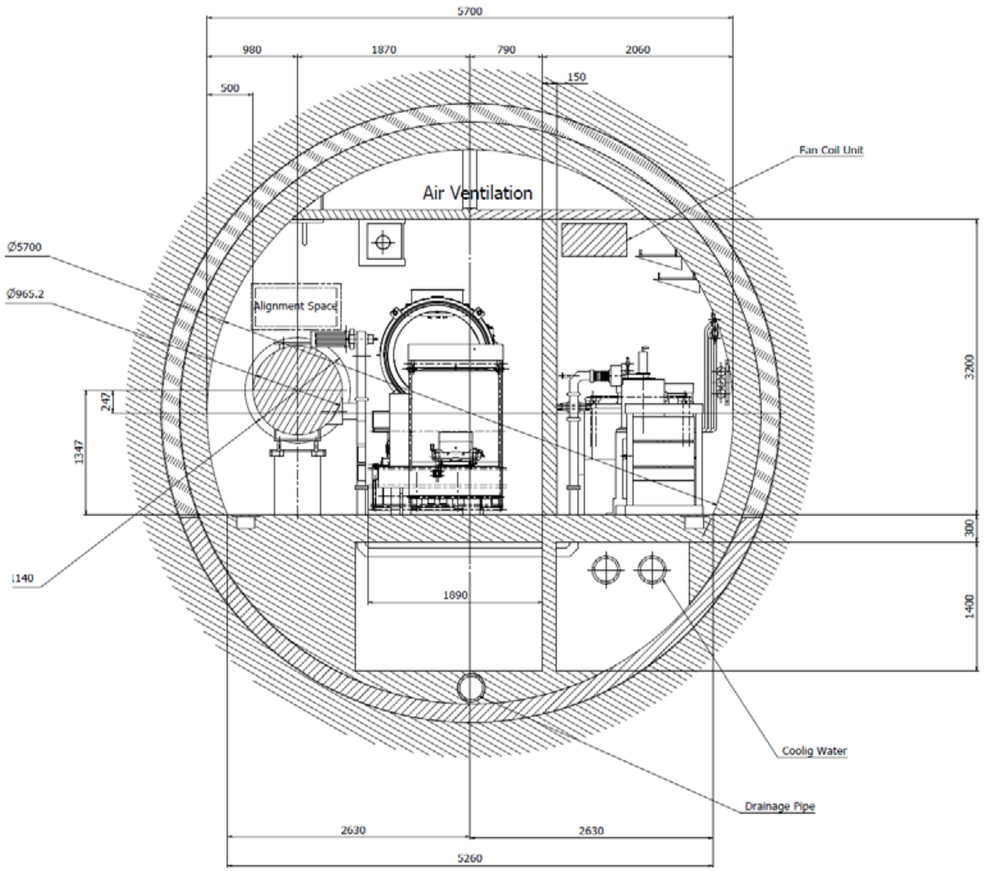
In FY12: Use resonant ring to test 'final design' bends and tap-in/off



DRFS Single Tunnel Dimension and Installation





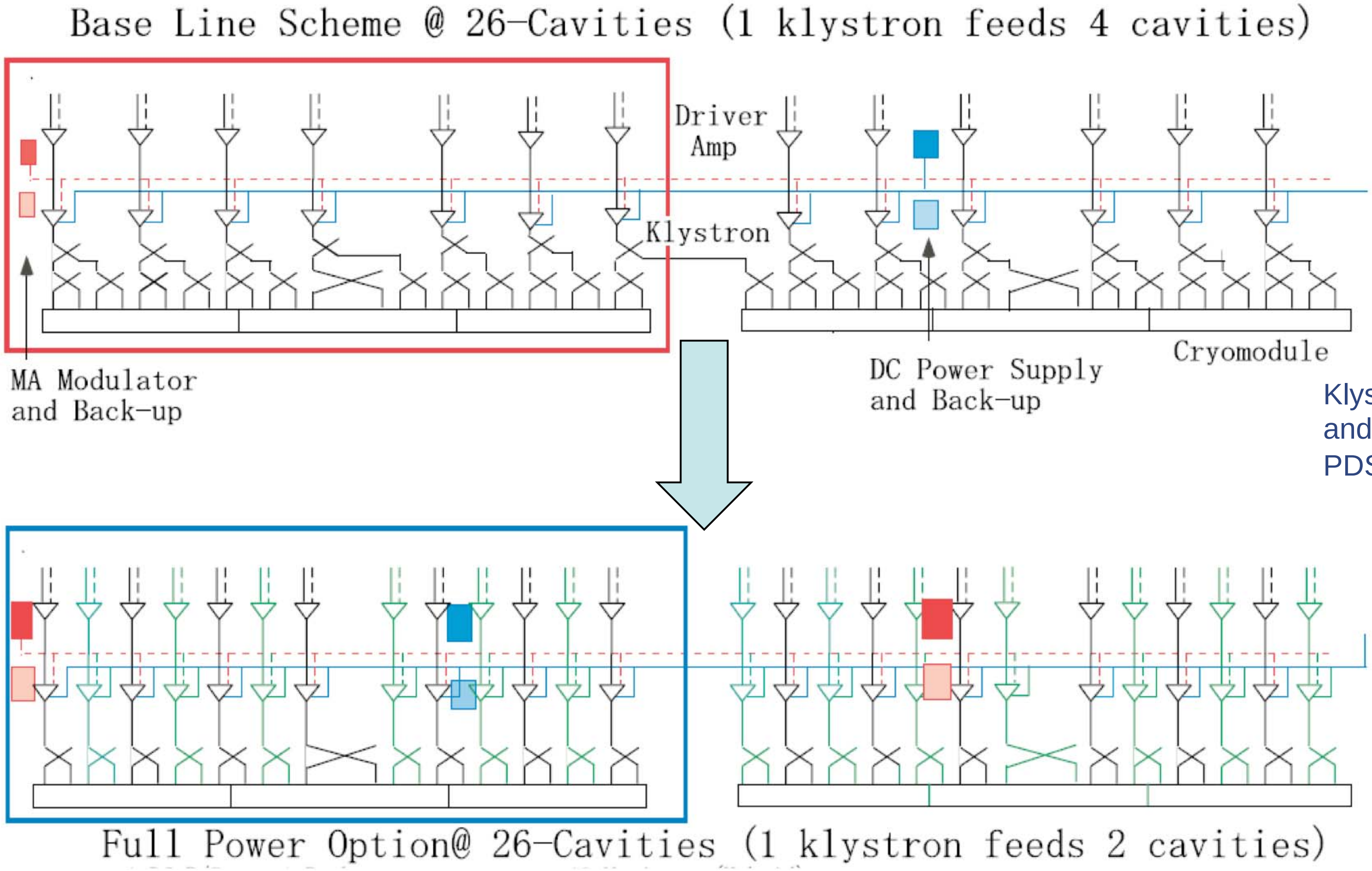


Upgrade to Higher Power Option

Response to PAC comment

- Installation of additional DRFS
  - **Estimate with extension of regular work of exchange of klystrons**
  - **May be handled within one year period**

Base line DRFS and upgrade pass



Klystrons, MA Modulator and DC P/S are increased.
PDS are changed.

Upgrade Scenario and time period

- Assumption for upgrade from SB2009 to Full ILC
  - **Infrastructures such as cooling water pipe work and electricity cabling are assumed to have been completed,**
    - though they are not used at the baseline stage.
  - **Main upgrade work/installation for HLRF**
    - just the installation of HLRF components and not included the CFS construction mentioned above.
  - **Estimation for labor works for HLRF installation**
    - performed in the similar manner as the maintenance scenario of DRFS.
- Different points from maintenance scenario of DRFS
  - **Additional DC power supplies (P/S)**
    - to be installed in the upgrade stage, while failure components are replaced in the maintenance scheme.
  - **Installation of DC P/S**
    - for 3days and test operation for 1 days are required for one PC P/S setting.
  - **PDS in the floor**
    - all installed at begging and only Hybrid replacement work is included.
  - **LLRF Rack and Control racks to be added..**

Installation Work for the HLRF Upgrade

Item	Baseline #	Upgrade #	# / Shaft	Required Man*Day
DRFS Klystron	3640	3640	455	2260
MA Modulator	420	420	52.5	292
DC P/S	420	420	52.5	14483
PDS(Hybrid Only)	3640	3640	455	1425
LLRF	420	280	35	125
Cont Rack	1120	1120	140	775
Total				19360

- From this table, if 4 person/shaft (32 person/whole), then 605 days.
- If 15 person/shaft (32 person/whole), then 161 days (about 32 weeks).
- This case upgrade is completed during the about 8 months.
- For the DC P/S installation, it is necessary to install two sets /shaft at the same time.
- IF more labors are employed, it is possible to finish upgrade construction in half year, and it is possibly handling scenario.

(* In above table, numbers of DC P/S and MA Modulator are 1.5 times number of regular units because of including backup sets

Global Plan for SCRF R&D

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Cavity Gradient in v. test to reach 35 MV/m	→ Yield 50%			→ Yield 90%		
Cavity-string to reach 31.5 MV/m, with one-cryomodule		Global effort for string assembly and test (DESY, FNAL, INFN, KEK)				
System Test with beam acceleration			FLASH (DESY) , NML (FNAL) STF2 (KEK, test start in 2013)			
Preparation for Industrialization			Production Technology			
Communication with industry:	2010: 2nd step: Organize Workshop (2010) 2011: 3rd step: Send specification & receive response					

To be reported, next

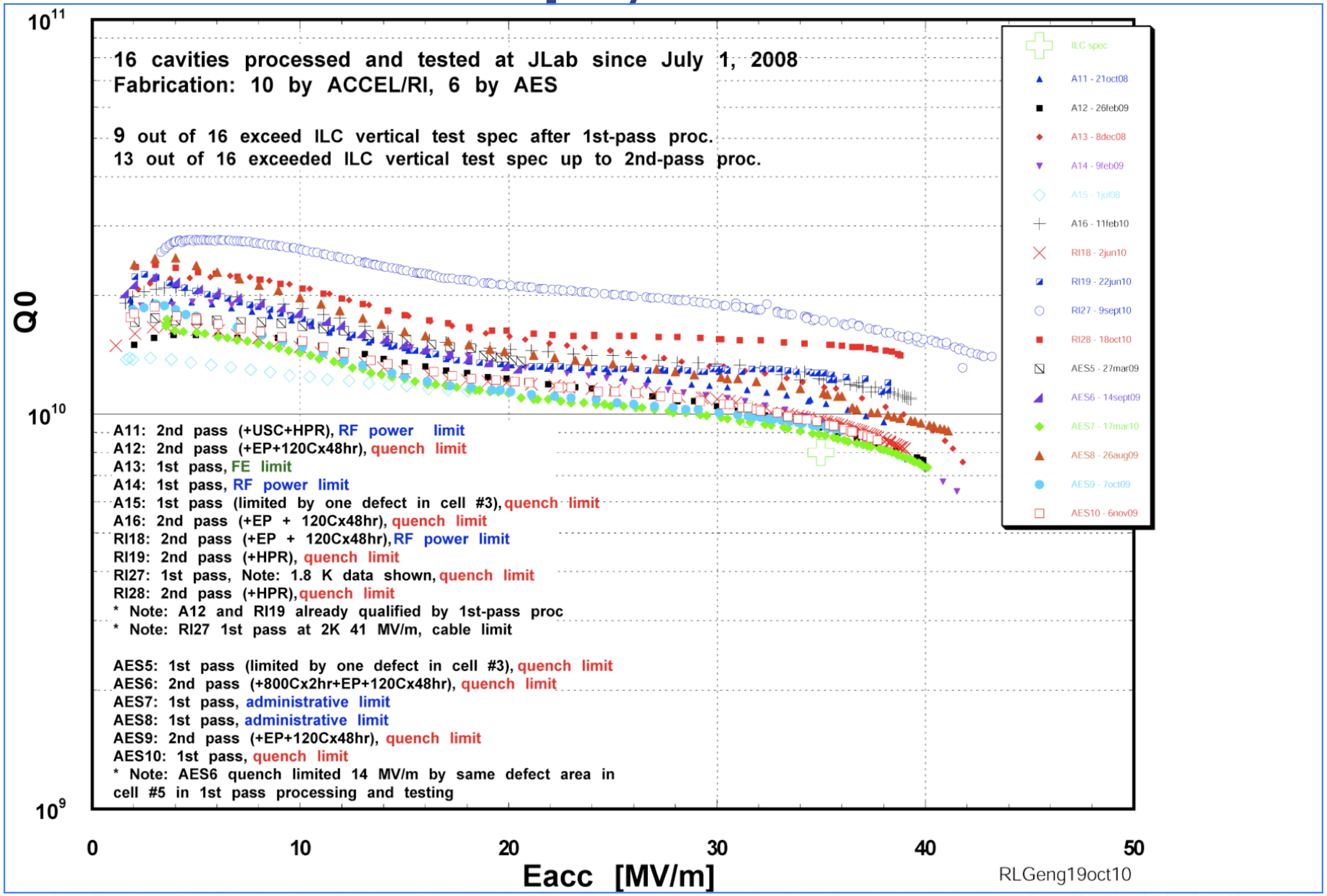
Summary

- **Cavity gradient R&D**
  - **R&D milestone:**
    - 35 MV/m at Q0 > 8x10E9, > 50 % yield achieved in TDP-1, 2010,
    - 35 MV/m, w/ > 90 % yield (eq. > 38 MV/m av.) anticipated in TDP-2.
  - **ML Acc. Gradient baseline: 31.5 MV/m with the spread ≤ +- 20 %**
- **Cryomodule Performace**
  - **S1-global module, achieving the av. gradient 28 MV/m**
    - in balance of the vertical test w/ 30 MV/m
  - **Cryomodule performance is conern,**
    - the drop of the gradient to be understood and improved,
- Preparation for the SCRF Industrialization
  - **To be discussed in the next report.**

Backup

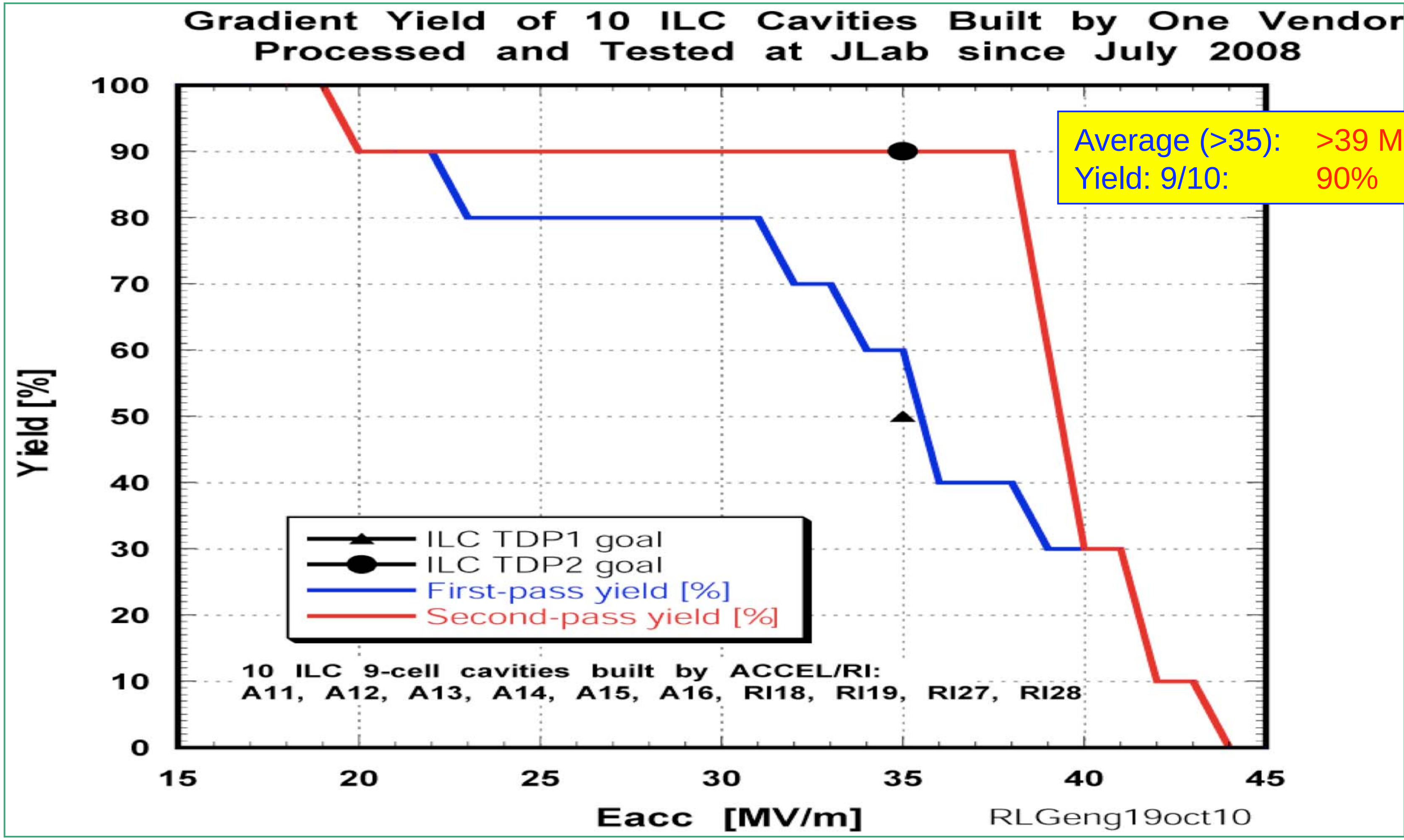
R. Geng

JLab Progress: Tesla-Shape, EP'ed Cavities



R. Geng

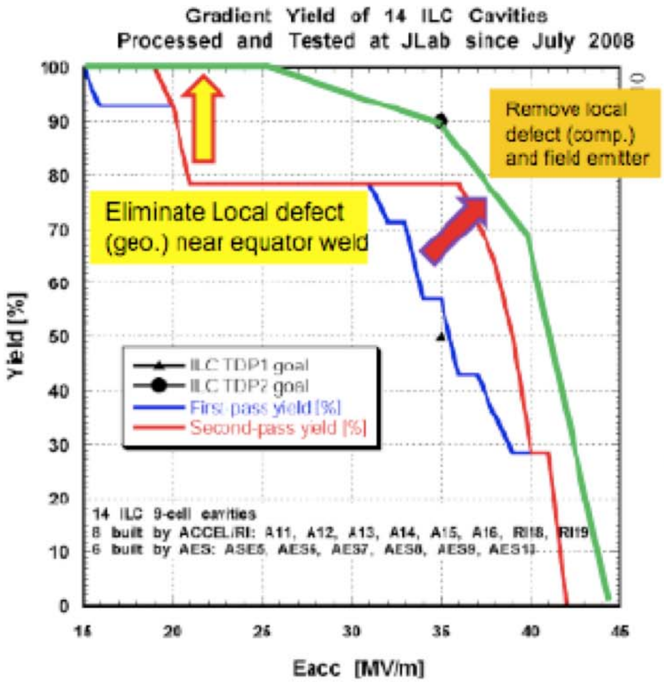
An Example of 35 MV/m at 90 %



Average (>35): >39 MV/m
Yield: 9/10: 90%

R. Geng

Near Term Plan for Improving Gradient and Yield



- Highest priority is to push yield up near 20 MV/m – the yield drop due to local (geometrical) defects near equator weld.
  - **Fabrication QA/QC**
  - **Mechanical polish prior to heavy EP**
  - **Post-VT local targeted repair**
  - **Seamless cavity**
  - **Large-grain mat. from ingot slicing**
  - **Fine grain mat. optimization**
- Also high priority is to suppress field emission at high gradient (up to 42 MV/m) – and quantify its effect on cryogenic loss and dark current.

Reliable and reproducible EP essential. Example now exists.
Pursuit is continuing in some facilities.

RL Geng 9Sept10 BAW1 **Global Design Effort** 34

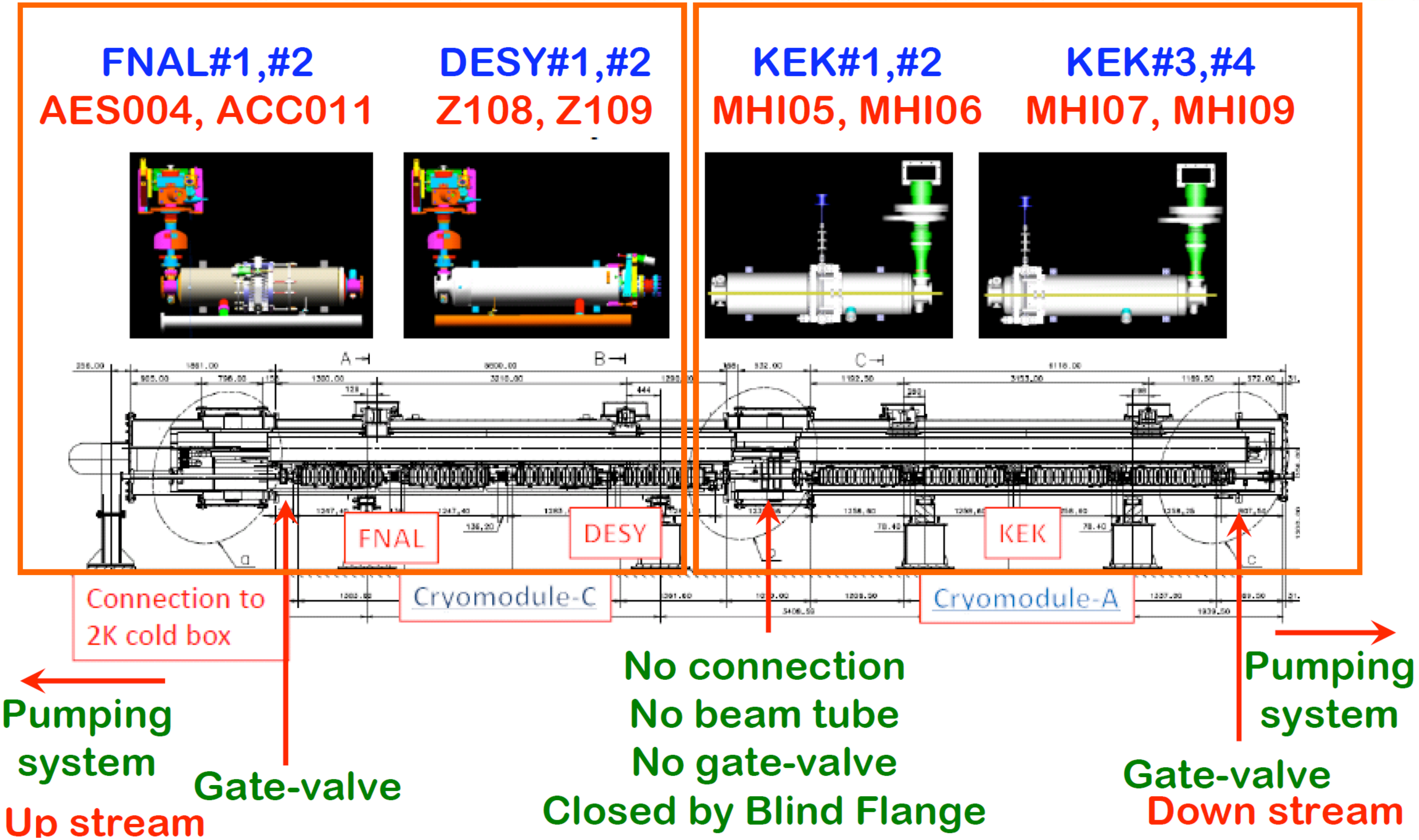
\# of fabrications
EU:
XFEL: 600+ x
FP7: 24

AMs:
ARRA: ~ 40 + x

ASs:
QB: 2
STF: 9 + x

Repairing:
- Optical inspection
- Local Grinding
- Barrel polishing
- Laser/EBW melting

Module S1-Global



BAW-1: Recommendations

1. Gradient
   - **Remain at 31.5 MV/m average accelerating gradient**
     - → fixed tunnel length
   - **Additional RF power to accommodate a spread in gradient (±20%)**
     - → higher mass-production yield expected ⇒ cost effective
   - **TDP2 R&D remains ≥35 MV/m low-power vertical test (90% yield)**
     - infers <*G*> ~38 MV/m VT (additional margin)

2. Single-Tunnel (Main Linac)

   → reported by N. Walker

   - **Go forward with SB2009 proposal**
   - **Both KCS and DRFS R&D have significantly progressed**
   - **Inclusion of RDR HLRF Technology option as back-up solution**

http://ilcagenda.linearcollider.org/conferenceTimeTable.py?confId=4593

Global Plan for SCRF R&D

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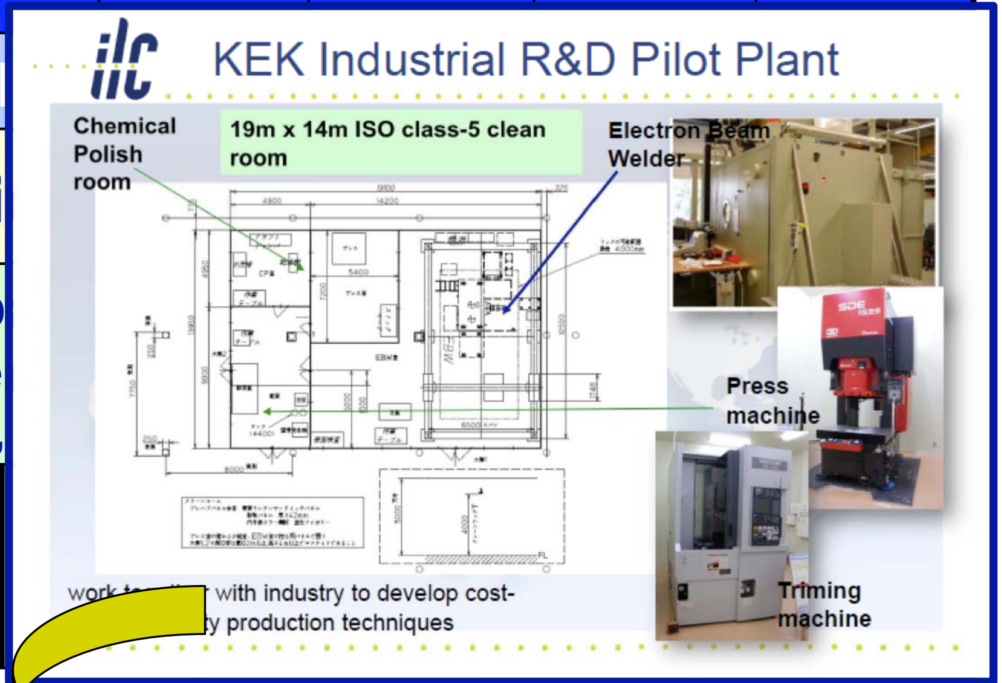
Phase		TI				
Cavity Gradient in v. test to reach 35 MV/m		→ Yi				
Cavity-string to reach 31.5 MV/m, with one-cryomodule		Glob asse (DESY,				
System Test with beam acceleration						
Preparation for Industrialization				Production Technology R&D		
Communication with industry:	2009: 1st step: Visit Venders (2009) 2010: 2nd step: Organize Workshop (2010) 2011: 3rd step: Send specification & receive response					



Global Plan for SCRF R&D

	2009	2010	2011	2012
	-1		TDP-2	
	d 50%		→ Yield 90%	
	effort for string ly and test			
beam accelerati n				
Preparati n for Industriali ation				
Communication with industry:	2009: 1st step: Visit Vendors (2009) 2010: 2nd step: Organize Workshop (2010) 2011: 3rd step: Send specification & receive response			

A Satellite Meeting at IPAC-2010

SCRF Cavity Technology and Industrialization

Date : May 23, 2010, a full-day meeting, prior to IPAC-2010
Place: Int. Conf. Center, Kyoto, Japan
Organized by: ILC-GDE Project Managers,

Actions for Preparing Industrialization

to be more discussed in another report

- General Plan for 2010-2011:
  - **Prepare for Preliminary “ILC Cavity Specification” and**
  - **Ask responses/advices from cavity/cryomodule vendors**
  - **Make our own effort for industrialization at laboratories,**
- Communication with Industry:
  - **Send/Explain a plug-compatible, build-print, specification**
    - Including design parameter, interfaces, manufacturing process,
    - Requirement on quality control
  - **Ask for the most practical industrial model including cost evaluation (depending on each vendors capacity)**
    - Scale of production: 4,000 ~ 8,000 (25 ~ 50 %, for example)
    - Possible industrial collaboration (grouping etc..)
    - Scale of production period: 2 + 6 years (pre-series + main production period, for example, in an assumption of more than double period of EXFEL construction period)

Plan for Communication with Industry

Period	Occasion	Action Items
Oct. 20	IWLC-10: GDE SCRF	Discuss ‘cavity and CM specification’ and industrial model, and study plan
Oct. 25-26	Visit DESY	Learn E-XFEL cavity and cryomodule specification and procurement
Nov. 11-12	ILC-PAC	Report the study plan / preparation plan for industry
Dec. 9	Visit Saclay	Learn E-XFEL cryomodule assembly contract: Hosted by Saclay lab., and contracted by companies
Jan.		Complete the technical specification, and Distribute it to possible vendors
April/ May		Receive responses from vendor
Oct.		Complete new cost estimate